Training Program

Module 9: Carbon Sequestration by Forestry and Agriculture

Prepared for:
The United States Agency for International Development
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Module Contents

Overview

Overview

- Background
- Participation
- Objectives
- Module Basics
- Materials
- Working Group Exercise
- Evaluation Process
- Agenda

Introductory session:

- Overhead Transparencies (PowerPoint Slides)

Session One: Current Status of International Negotiations and Decisions on Sinks

- Overview
- Reading and Resources
- Overhead Transparencies (PowerPoint Slides)

Session Two: Technical Issues in National Sinks Accounting

- Overview
- Reading and Resources
- Overhead Transparencies (PowerPoint Slides)

Session Three: Carbon Dynamics in Agricultural and Forestry Systems

- Overview
- Reading and Resources
- Overhead Transparencies (PowerPoint Slides)

Session Four: Potential of Carbon Sequestration by Ukraine's Forests

- Overview
- Overhead Transparencies (PowerPoint Slides)

Session Five: Monitoring, Evaluation and Verification of Carbon Sequestration by Forests of Ukraine

- Overview
- Overhead Transparencies (PowerPoint Slides)

Session Six: Issues in Project Development

- Overview
- Reading and Resources

- Overhead Transparencies (PowerPoint Slides)

Session Seven: Agriculture and Forestry Sequestration Projects
- Overview
- Reading and Resources
- Overhead Transparencies (PowerPoint Slides)

Session Eight: Environmental, Social, and Economic Issues in Project Development
- Overview
- Reading and Resources
- Overhead Transparencies (PowerPoint Slides)

Session Nine: Risk Management Issues in Project Development
- Overview
- Reading and Resources
- Overhead Transparencies (PowerPoint Slides)

Session Ten: Calculating Emission Reduction Credits in Project Planning
- Overview
- Reading and Resources
- Overhead Transparencies (PowerPoint Slides)

Session Eleven: Developing Sequestration Project Plans
- Overview
- Reading and Resources
- Overhead Transparencies (PowerPoint Slides)

Session Twelve: Case Study from the United States – The Tramway Project
- Overview
- Reading and Resources
- Overhead Transparencies (PowerPoint Slides)

Session Thirteen: Case Study for Ukraine: Afforestation Project in Kharkiv Region (Ukrlis-Kharkiv)
- Overview
- Overhead Transparencies (PowerPoint Slides)

Session Fourteen: Case Study – The RUSAFOR Project
- Overview
- Reading and Resources
- Overhead Transparencies (PowerPoint Slides)

Session Fifteen: Potential Financial Support for Sequestration Projects
- Overview

- Reading and Resources
- Overhead Transparencies (PowerPoint Slides)

Materials

- Evaluation Form
- Participant Handouts

Overview

Background

This module is the ninth in a series of nine, which comprise the Climate Change Initiative's (CCI) near-term training program in Ukraine. As a complete package, these modules are intended to build awareness on climate change issues among a wide group of stakeholders.

Module Nine, *Carbon Sequestration in Agriculture and Forestry*, is designed to build on the previous modules, and provide participants with a broadened understanding of the potential role for sequestration projects and activities in the agricultural and forest sectors. The module focuses on: the physical processes involved in agriculture and forest carbon dynamics, methods of planning projects and calculating potential carbon sequestration impacts, consideration of associated environmental issues that have arisen in the international policy arena, and some of the financial mechanisms that may become available to help Ukraine with these activities.

Material for the module was adapted for Ukraine from existing publications and reports; including the *Special Report on Land Use, Land-use Change and Forestry* released by the Intergovernmental Panel on Climate Change in June, 2000; papers from the professional literature, and materials presented at the 7th Conference of the Parties to the United Nations Framework Convention on Climate Change, held in Marrakech in November, 2001.

Participation

The ideal audience for this module includes senior level ministry officials, field specialists and professionals in natural resource agencies, and representatives of industry groups and non-governmental organizations. Participants with a technical background in agriculture, science, engineering, forestry, or economics will also benefit.

Objectives

This module aims to impart an enhanced understanding of the role of carbon sequestration ("sinks") in the basic challenge of responding to climate change – including participation in the UNFCCC and meeting the terms of the Kyoto Protocol. It will help participants work with project design, planning, evaluation, and implementation in the event that market opportunities and emissions trading become more common. It reflects some uncertainty at this stage, because many decisions affecting the role of sinks, both in national accounting and emissions trading, are yet to be taken. It will, however, help to familiarize Ukrainian decision-makers and stakeholders with the core issues and challenges involved in the inclusion of sequestration projects as part of the climate change opportunity facing the nation.

The long-term goal is an enhanced and lasting awareness of the role of agriculture and forestry in addressing climate change issues, and the beginning of a functional consensus among key stakeholders on how to approach and manage these activities as part of the climate change program in Ukraine.

Module Basics

- ***Duration***: 4 days
- ***Participants:*** 30-45
- ***Venue:*** Kiev (cities of Ukraine)
- ***Facilities (recommended):*** The module can be presented in any comfortable training facility. Adequate space for plenary presentations should be made available. The working group exercises on day 3 will require some breakout areas that can accommodate from 3 to 5 working groups.
- ***Format:*** Workshop; fifteen sessions over 3-1/2 days; each consisting of a (typically) 30-minute long presentation, including a question and answer period.
- ***Instructor:*** Between 2 and 6 subject matter and Ukrainian experts
- ***Audio/Visual Needs:*** Laptop computer and LCD projector if using PowerPoint, Overhead projector if the PowerPoint slides are converted to transparencies
- ***Contacts:*** Natalia Kulichenko and Natalya Parasyuk of CCI, Dan Thompson (USAID), Neil Sampson of The Sampson Group, Inc., Igor Buksha of the Institute of forestry and agriculture melioration

Materials

The module provides several types of material for use during both the preparations of the workshop, and the workshop itself. This material is outlined below.

Session Overview: The session overviews are “blueprints” for each of the seventeen sessions. The overview of each session provides a summary of the session, listing basic information, such as the general objective, total time, and type of activities involved.

Presenters are encouraged to:

- review this guidance material carefully,
- practice using the PowerPoint slides or OHTs
- note the time it takes to deliver each slide
- mark your comments and modifications in each page.

PowerPoint Files for Overhead transparencies: The PowerPoint presentations are divided into individual files according to sessions. If desired, they can easily be printed as overhead transparencies (OHT's) for that form of presentation. Each set of slides is numbered consecutively and has titles based on their content. Presenters are encouraged to give participants sufficient time to read and understand each slide.

Reading and Resources: Citations for a number of key reports are included for further reference on the subject of the basics of carbon sequestration in agriculture and forestry.

Participant Materials: This material consists of a series of handouts. Only one copy of each of the handouts (such as forestry sequestration project plan), is included in the workshop package. Copies of the handouts should be made prior to the workshop. The session plans tell the presenter when to distribute the handouts and how to guide the speaker in using them properly. The presenter may wish to ask someone to help distribute handouts to save time. Presenters are encouraged to make certain that enough copies of the handouts have been prepared, and to arrange the handouts so that they can be distributed with ease during the workshop.

Working Group Exercise**:** The working group exercise is designed to help participants put the information learned in the sessions to practical use. In the exercise, the participants are divided into working groups of 4-8 people; ideally 5-6. They are assigned the task of developing a preliminary project plan, either on a proposal with which they are familiar, or with one provided by the workshop coordinators (see below). They choose one of their groups to present the proposal to the entire workshop, where questions and discussion are encouraged.

The goal is to help participants work through the issues involved in developing a carbon sequestration project plan. An outline is provided for the exercise, and they can fill in the blanks to document the their proposal. The major challenge is to get participants to develop a realistic base case and carbon baseline; to outline a realistic project plan; and to calculate the amount of carbon sequestered as a result of the project. The plan should consider all of the issues discussed in the workshop, including the ancillary impacts and benefits of the project.

For possible use in the event that participants do not bring project information to use, here are 4 scenarios that they can be challenged to address:

1. An afforestation project in the forest steppe region of Ukraine. The project would establish, manage, and protect 330 ha of oak forest on marginal, eroding agricultural lands. The project duration is 60 years.
2. An afforestation project in the steppe region of Ukraine. The project would establish, manage, and protect 150 ha of deciduous forest and 50 ha of pine on marginal, eroding agricultural land. The project duration is 50 years.
3. An afforestation project in the Carpathian region of Ukraine. The project would establish, manage, and protect 200 ha of hilly, eroding soils. The project duration is 80 years.
4. An afforestation project on the contaminated lands in the Chernobyl area of the Polissya region. The project would reforest land that has been taken over by grass and shrubs since the accident, on the basis that not only will more carbon be sequestered, but that the migration of nuclear elements will be reduced under forest cover. The project will plant 275 ha of oak and pine mixed forest. The project duration is 50 years.

Participants are asked to present a plan that estimates baseline conditions, develops both baseline and project scenarios for the project duration, estimates total carbon sequestration for the project, and analyzes costs, the value of ancillary benefits, and any other aspects they can present.

Evaluation Process

Module Nine will need to be evaluated in order to improve the workshop package for more effective subsequent use. The evaluation can be conducted using a simple questionnaire, developed earlier in the CCI Training Program. At the close of the workshop, the organizer should ask the participants to take five to ten minutes to complete the evaluation form. Participants need to be asked to put down their names on the forms.

Agenda

The agenda for Module nine appears on the following pages.

AGENDA
MODULE 9: CARBON SEQUESTRATION IN AGRICULTURE AND FORESTRY
DAY 1

09:30 – 10:00	REGISTRATION
10:00 – 10:30	OPENING REMARKS REPRESENTATIVES OF STATE FORESTRY COMMITTEE OF UKRAINE, USAID, CCI
10:30 – 10:45	COURSE OUTLINE AND SCHEDULE
10:45 – 11:15	FORESTRY OF UKRAINE AND ITS ROLE IN REDUCING GLOBAL CLIMATE CHANGE RISK
11:15 – 11:30	*BREAK*
11:30-12:00	CURRENT STATUS OF INTERNATIONAL NEGOTIATIONS AND DECISIONS ON SINKS (COP 7)
12:00 – 13:00	TECHNICAL ISSUES IN NATIONAL SINKS ACCOUNTING (LANGUAGE FROM KYOTO 3.3 AND 3.4., THE IPCC SPECIAL REPORT, AND FROM COP 6 – 6.5 AND 7 AS APPROPRIATE)
13:00 – 14:90	*LUNCH*
14:00 – 15:00	INTRODUCTION TO BASIC CARBON DYNAMICS IN AGRICULTURAL SOILS AND FOREST ECOSYSTEMS
15:00 – 15:15	*BREAK*
15:15 – 16:00	THE POTENTIAL FOR FORESTRY SINKS IN UKRAINE – SOME RESULTS FROM THE CSP AND SCEFORMA
16:00 – 16:30	THE NATIONAL FOREST MONITORING AND FOREST CERTIFICATION PROGRAMS
16:30 – 17:00	DAY 1 SUMMARY

DAY 2

09:45 – 10:00	INTRODUCTION TO DAY 2 PROGRAM
10:00 – 11:00	ISSUES IN PROJECT DEVELOPMENT. PROJECT CREDIBILITY ISSUES (ADDITIONALITY, LEAKAGE, PERMANENCE, VERIFICATION)
11:00 – 11:15	*BREAK*
11:15 – 12:00	AGRICULTURE AND FORESTRY CARBON SEQUESTRATION PROJECTS. GENERAL PROJECT CHARACTERISTICS AND ISSUES
12:00 – 12:45	ENVIRONMENTAL, SOCIAL, AND ECONOMIC ISSUES IN PROJECT PLANNING
12:45 – 13:45	*LUNCH*
13:45 – 14:15	RISK MANAGEMENT ISSUES IN PROJECT DEVELOPMENT
14:15 – 15:00	CALCULATING EMISSION REDUCTION CREDITS IN PROJECT PLANNING
15:00 – 15:30	DEVELOPING PROJECT PLANS
15:30 – 15:45	*BREAK*
15:45 – 16:15	CASE STUDY BASED ON US CASE (TRAMWAY)
16:15 – 17:00	CASE STUDY BASED ON UKRAINIAN CASE
17:00 – 17:15	DISCUSSION AND DAY 2 SUMMARY

DAY 3

09:45 – 10:00	INTRODUCTION TO DAY 3 PROGRAM
10:00 – 10:30	CASE STUDY – AIJ PROJECT REPORT ON RUSAFOR PROJECT
10:30 – 11:00	POTENTIAL FINANCIAL SUPPORT FOR SEQUESTRATION PROJECTS IN UKRAINE
11:00 – 11:15	*BREAK*
11:15 – 11:30	EXPLAIN WORKING GROUP EXERCISE; DESIGNATE WORKING GROUP LEADERS AND EXPLAIN SCHEDULE FOR WORKING GROUP ACTIVITY
11:30 – 13:00	INITIAL WORKING GROUP ACTIVITY – EACH WORKING GROUP SELECTS A CHAIR PERSON AND A RECORDER, WHO WILL DOCUMENT THE WORKING GROUP'S PROJECT PROPOSAL AND PRESENT IT TO THE MAIN GROUP. THE GROUP BEGINS TO WORK ON THEIR PROJECT
13:00 – 14:00	*LUNCH*
14:00 – 16:00	WORKING GROUP ACTIVITY (CONTINUED)
16:00 – 16:20	*BREAK*
16:20 – 17:00	FINAL SESSION. WORKING GROUP ACTIVITY

DAY 4

09:45 – 10:00	INTRODUCTION TO DAY 4 PROGRAM
10:00 – 11:30	WORKING GROUPS PRESENT PROJECTS PROPOSALS AND PLANS. EACH TEAM HAS 10 MINUTES FOR PRESENTATION; 10 MINUTES FOR DISCUSSION
11:30 – 12:00	DISCUSSION OF WORKING GROUP PRESENTATIONS BY INTERNATIONAL AND LOCAL EXPERTS
12:00 – 13:00	*LUNCH*
13:00 – 13:30	COURSE SUMMARY AND CONCLUSIONS

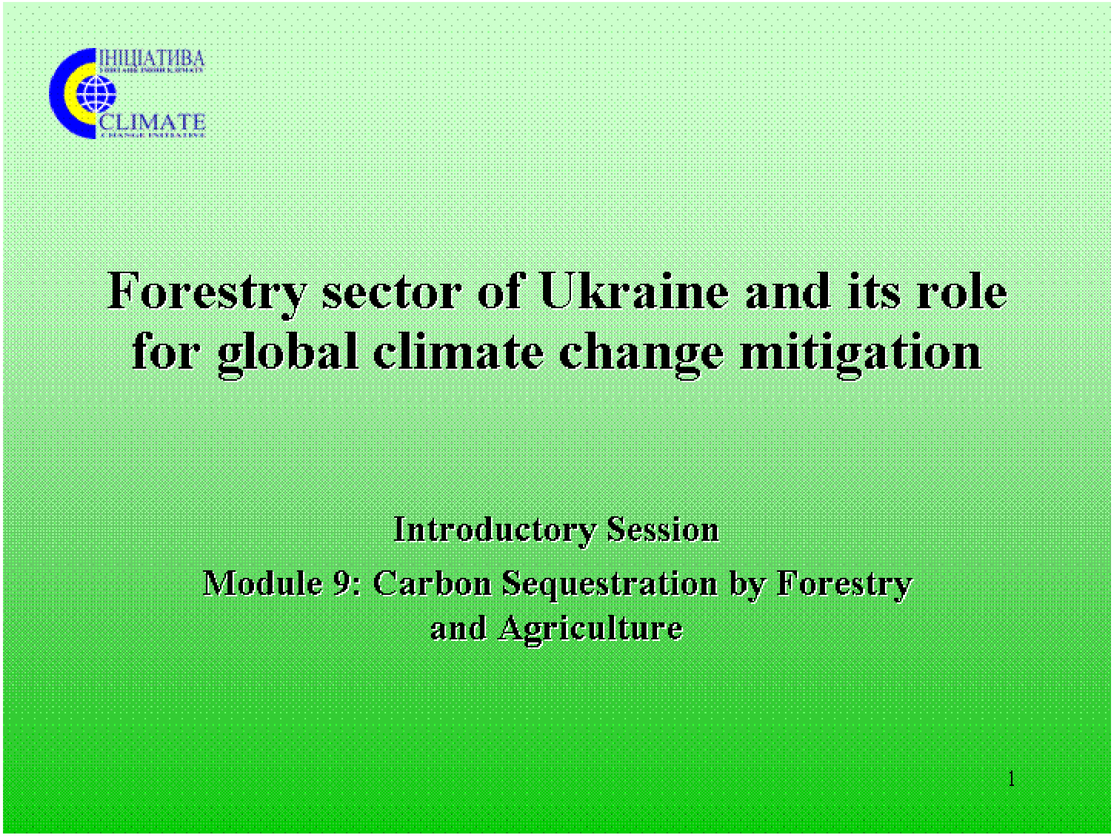
MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Introductory Session: Forestry sector of Ukraine and its role for global climate change mitigation

In compliance with the preliminary agenda we suggest that presentations should cover the review of the current situation in the sphere of forestry and agriculture of Ukraine (trends, features, investments).

Information should be updated depending on the development of new programs and strategies regarding the forestry and agriculture.

It is recommended to invite authors of programs and strategies for presentation of their developments.



Forests and climate change

- The social role of forests has been growing as humankind becomes more and more aware of forests' contribution to the environment stabilization and abatement of global climate change risk
- The international community recognizes mitigation forestry projects as ones of the most attractive, environmentally safe and cost-effective ways to prevent further human-induced degradation and devegetation activities

2

International decisions on forests related to climate change

- UN Framework Convention on Climate Change
- Kyoto protocol

The second round of the 6th session of the Conference of Parties (Bonn, July 2001) decided that *the eligibility of land-use, land-sue change and forestry project activities is limited to afforestation and reforestation*

3

Decisions of the COP7, (Morocco, 2001)

•Pilot JI project phase extension

•Possibility of transferring the greenhouse gas emission/reduction (removal) units

Gave a green light to the forestry mitigation projects, including JI projects that enable foreign investment into the forestry sector

4

Legal framework for JI projects in Ukraine

- The Law of Ukraine on the UNFCCC ratification
- Cabinet of Ministers Resolution # 583 of April 14, 1999, on Interministerial Commission on Climate Change

5

Countries - potential donors of JI projects

- Australia, Canada, Denmark, Great Britain, Netherlands, Norway, Japan, New Zealand, and USA are interested in investing in the JI projects in Ukraine

6

Existing JI Projects

- Russia, 1994 - pilot JI project "Afforestation in Saratov oblast" (RUSAFOR) - creating 900 hectares of pine trees, conservation and monitoring
- GEF management allocated USD 4.5 M to plant trees and other plants on degraded forest grazing lands in Columbia, Costa-Rica, and Nicaragua

7

Forest land in Europe and in Ukraine

Region	Total area, thousand hectares	Forest area, thousand hectares	Percentage of forest land
Total Europe	2,260,128	933,326	41.3
Northern Europe	112,329	52,538	46.8
Western Europe	245,569	59,479	24.2
Eastern Europe	1,902,230	821,309	43.2
Ukraine	60,350	9,400	15.6

(Source: State of the World Forests 1999, FAO, 154 p.)

8

Ukraine's potential in forestry JI projects

- Forests cover only 15.6% of the territory of Ukraine, while average percentage of forest land for Europe is 43.2%. Forests expansion is possible due to availability of lands that are not suitable for agriculture
- More than 15 million hectares of land are eroded in Ukraine, 80 thousand hectares get eroded annually. Most of these lands could be used for afforestation.

9

Ukrainian forest reserve

- Total forest land reserve - 10.8 million hectares
- Land covered with forest - 9.4 million hectares
- The optimum forest cover for Ukraine is 12 million hectares (~20%). It is desirable to plant additional 2.5 million hectares of forest.

10

Land owned by the State Committee for Forestry of Ukraine, 1996

Forests age structure

- average forest stand age - 51 years
- young plants - 31%
- middle-aged plants - 45%
- premature plants - 13%
- mature plants - 11%

General stock - 1733.58 million m^3, including

- young plants - 314.08 million m^3,
- middle-aged plants - 870.27 million m^3,
- premature plants - 298.97 million m^3,
- mature plants - 250.26 million m^3,

11

Accounting Sequestered Carbon

- Natural increase of the sequestered carbon due to the forest age changes is not accountable for the Kyoto protocol commitments
- ADDITIONAL carbon removal due to the forest biomass growth (resulted from refforestation, afforestation, forest conservation and productivity increase) is accounted only
- Specific research needed to estimate carbon sequestration by various components of forest ecosystem

12

Carbon removal by forests: limitations introduced by COP6.5

- Carbon sinks are volume is capped by an assigned amount that can be revised upon the country's request no later than December 31, 2005
- These assigned amounts are results of expert estimates, so the local forest feature were not taken into consideration
- The sequestration amount cap derived from FAO forest resources estimates (TBFRA 2000), accounting for forest biomass absorption only, rather then for all the ecosystem components, while forest soils can absorb up to 50% of carbon stored by forest ecosystem

13

Carbon removal by forests: limitations introduced by COP6.5 (cntd)

- The allowed additional carbon removal by forests for Ukraine is 1,11 MtC per year. It is one of the largest assigned amounts in Europe and corresponds country's large afforestation potential.
- This amount can be generated by the middle aged forests over the area of 1 million hectares approximately.

14

Ways to increase carbon sequestration by forests:

- Increase area of forest plantations
- Increase the productivity of forest plantations
- Forest conservation, protection from pests, diseases, and fires

15

Imperative for national forest management system:

- Increase trees productivity;
- Improve forest resistance to unfavorable environment conditions, diseases, pests;
- Protect and conserve forests.

New forest plantations are of most interest to potential investors under JI mechanism

16

Participation in JI projects will allow to:

- Obtain international financial and technical assistance regarding the advanced forest management practices;
- Attract additional funds to optimize country's forest cover, create new forests and improve the environment;
- Improve the image and the social importance of foresters, who work to reduce the threat of global environment change;
- Strengthen Ukraine's authority internationally thanks to climate protection activities

17

Ukraine's possibilities for forest growth

The foresters of Ukraine are capable of implementing the whole cycle of forest growth (technical, design and research support).

The state Committee for Forestry possesses:

- scientifically based and use-proved technologies for producing high productivity and high tolerance plantations
- over 100 greenhouses and seed spots growing over 250 M pieces of standard planting stock
- about 16 thousand hectares of permanent forest seed areas and plantations for high quality planting stock preparation
- qualified professionals

18

Social benefits from implementing JI projects in forestry sector

- Additional investments into forestry sector;
- Comprehensive approach to resolving environmental, social and economic issues: preventing land erosion, air protection, reducing water pollution, conserving biodiversity, increasing employment in rural areas, increasing the forest production output.

The State Committee for Forestry is confident that the JI projects in the forestry sector are beneficial to Ukraine, and encourages cooperation of the governmental and non-governmental organizations, research institutions, national and foreign investors, international financial and technical assistance.

19

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 1: Current Status of International Negotiations and Decisions on Sinks

1. Overview

General Objectives: Session 1 will introduce students to the present status of the international negotiations on the Kyoto Protocol. It will provide a brief background starting with the UN Framework Convention on Climate Change and the subsequent process. Decisions made at the most recent meetings of the Conference of Parties (COP) will be included.

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 30 minutes

Materials: Set of 25 PowerPoint charts

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

2. Reading and Resources

For continuing current information on the negotiations, meetings, special studies, and decisions, see the UNFCCC web site: http://www.unfccc.int

Current Status of International Negotiations and Decisions on Sinks

Session 1

Module 9: Carbon Sequestration by Forestry and Agriculture

1

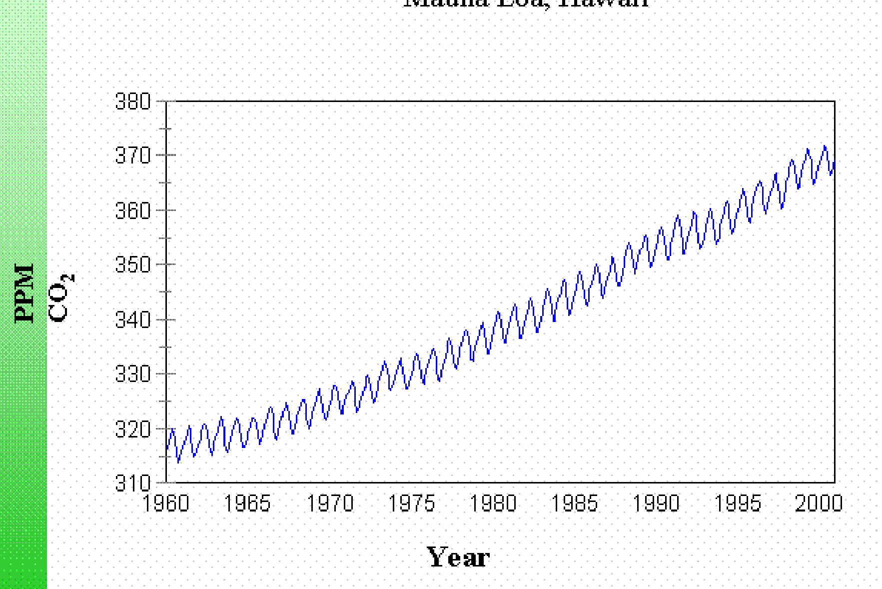
Climate Concern

- Began in the late 20th Century
- Greenhouse effect
  - Well established in scientific literature
  - Some chemical compounds trap heat within the earth's atmosphere, increasing energy that affects global climate
    - Carbon dioxide (CO_2) is most common
    - CO_2 levels have risen for 150 years, largely as a result of fossil fuel burning and land use change.

2

Atmospheric CO2 Concentrations

Mauna Loa, Hawaii



Source: http://cdiac.esd.ornl.gov/trends_html/trends/co2

3

Land Use and Forests in Climate Change

- While the burning of fossil fuels is the largest contributor to emission of greenhouse gases, 20% of the current increase in greenhouse gas concentration is due to land use change.
  - Clearing of forests, with loss of forest carbon due to burning of trees and reduction in carbon dioxide uptake through photosynthesis.
  - Loss of soil carbon due to cultivation and soil erosion following deforestation.

4

Earth Summit in Rio, 1992

- Set up U.N. Framework Convention on Climate Change (UNFCCC)
  - First formal international agreement that global climate change was a shared problem for all nations.
  - Defined climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere."
  - Established objective of stabilizing greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human influence on global climate.
  - Recognized differences between industrial and developing nations, in terms of responsibility.

5

UNFCCC

- Signed by 175 Nations, who committed to reduce greenhouse gas emissions to 1990 levels by 2000.
- Established the principle that Nations should work cooperatively where possible (activities implemented jointly)
- The U.S. ratified the Convention, and in 1993 created the U.S. Initiative on Joint Implementation under its Climate Change Action Plan.

6

Conference of the Parties

- COP 1 Berlin, 1995
  - Recognized Rio goal wouldn't be met
  - Voluntary measures would not be enough
  - Adopted "Berlin Mandate," agreeing that emissions limits would not be imposed on developing countries.
- COP 2 Geneva, 1996
  - U.S. lays out proposal for market-based mechanisms, and "international trading regime"
    - This represented a significant departure from regulatory-based approaches
    - Recognized the changing global economic context with many economies in transition.

7

The Kyoto Protocol

- Prior to the Kyoto meeting, the U.S. Senate, in a 95-0 vote, resolved that ratification would depend on:
    - "meaningful participation" of developing world
    - analysis of costs to U.S. economy
- Several important concepts were adopted, including:
  - Legally-binding targets on industrial countries (Annex B)
  - Established a 5-year period (2008-2012) as the first commitment period, with emissions then compared to 1990. (Later periods to be negotiated)
  - Specifically calls attention to both sources and sinks as potential approaches to meet commitments

8

Kyoto Protocol

- Annex 1 (developed) countries committed to reduction targets (listed as Annex B in the KP)
- Introduced "flexibility mechanisms" to help achieve these reductions
  - Emissions trading (between Annex B Parties)
  - Joint Implementation (Annex 1 with Annex 1 Parties)
  - Clean Development Mechanism (Annex 1 with non-Annex 1 Parties)
- Must be ratified by legislative bodies in 55 countries, representing 55% of Annex I 1990 GHG emissions

9

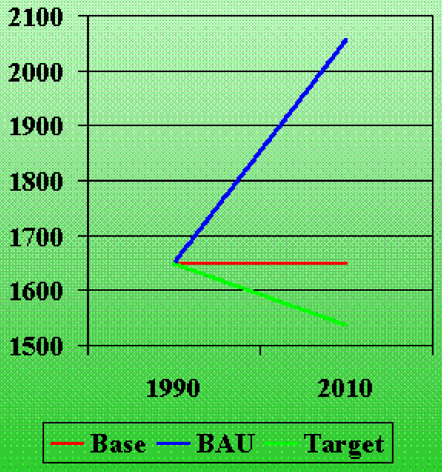
Reduction Commitments

- Overall reduction: 5.2% from 1990 baseline
  - 8% reduction for EU, most Eastern Europe, & Switzerland
  - 7% reduction for U.S.
  - 6% reduction for Canada, Hungary, Poland & Japan
  - 5% reduction for Croatia
  - 0% (stabilization) for Russia, Ukraine & New Zealand
  - Increases for Norway, Iceland and Australia

10

Kyoto Targets for U.S.

- Emissions in 1990 were 1650 MMTCE
- BAU for 2010 would be ~2055 MMTCE
- Reduction to 7% below 1990 would be a 33% reduction from 2010 BAU.



11

Land Use in the KP

- Several important articles related to the use of land use, land use change, and forestry activities in meeting commitments.
  - Article 3.3 – Three forest changes that must be included in Annex I accounting:
    - Afforestation, reforestation, deforestation
  - Article 3.4 – Additional land use, land use change and forestry activities that could be allowed with future rules & decisions.
  - Article 6 – Activities implemented jointly between Annex 1 countries.

12

Article 3.3

- "The net changes in greenhouse gas emissions by sources and removals by sinks resulting from **direct human-induced** land-use change and forestry activities, limited to **afforestation, reforestation and deforestation** since 1990, measured as **verifiable changes in carbon stocks** in each commitment period, shall be used to meet the commitments under this Article of each Party included in Annex B."

13

Article 3.4

- "The Conference of the Parties … shall … decide upon modalities, rules and guidelines as to **how**, and **which, additional human-induced activities** related to changes in greenhouse gas emissions by sources and removals by sinks in the **agricultural soils** and the **land-use change and forestry** categories shall be added to, or subtracted from, the assigned amounts for Parties included in Annex I, taking into account **uncertainties, transparency in reporting, verifiability**… ".,

14

Intergovernmental Panel on Climate Change (IPCC)

- Established in 1988 by World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to:
  - Assess available information on the science, the impacts, and the economics of climate change
  - Provide requested advice to the Conference of Parties (COP) to the UNFCCC.
- Involves thousands of scientists, nominated by their governments, who work on study groups and reports.

15

IPCC Report

- Intergovernmental Panel on Climate Change (IPCC) asked by COP to prepare a scientific and technical report on implementing Articles 3.3 and 3.4, as well as impacts on project activities and Joint Implementation.
- Land Use, Land-use Change, and Forestry: A Special Report of the IPCC. June, 2000. http://www.grida.no/climate/ipcc/land_use/

16

IPCC Special Report

- Designed to be useful for policy, but not to make or prescribe policy.
- Tried to show the options available on the questions, and the implications of each option.
- Involved several hundred scientists and reviewers

17

IPCC Special Report

- Illustrated the importance of carbon flows between the atmosphere and the biosphere that are directly affected by human action, and estimated the potential climate and other benefits that could be achieved by encouraging people to adopt more carbon-conserving practices.

18

IPCC Special Report

- Illustrated the importance of establishing definitions that all Parties could accept and utilize.
  - Forest
  - Afforestation
  - Deforestation
  - "Additional Activities"

19

IPCC Special Report

- Illustrated the importance of establishing carbon accounting systems that were available to all parties, and for which data were available.
- Discussed the difficulty in determining "direct human-induced changes" under many situations with current scientific tools.

20

Conference of the Parties

- COP 6, The Hague, 2000
  - Focused on implementation of Articles 3.3 and 3.4, as well as 6 and 12. Suspended negotiations without reaching decisions.
- COP 6.5, Bonn, 2001
  - Resumed discussion on role of sinks in implementing Articles 3.3, 3.4, 6 and 12. Agreement was reached, but not accepted by the United States.

21

COP 6.5 Decisions on Sinks

- Definitions of “forest,” “afforestation,” “reforestation,” and “deforestation” are on the basis of a change in land use.
- “Forest management,” “cropland management,” “grazing land management,” and “revegetation” are eligible activities under Article 3.4.
- To use these activities in first commitment period accounting, parties must select them before the period begins.
- Activities must have occurred since 1990 and be human-induced.

22

Conference of the Parties

- COP 7, Marrakech, 2001
  - Finalized the Bonn decisions on LULUCF
- COP 8,
  - To focus on implementation of Clean Development Mechanism (Article 12).
- COP 9
  - To consider several IPCC reports on:
    - Methods to estimate sinks (3.3, 3.4, 6, and 12)
    - Good Practice Guidance
    - Methods to factor out human-induced changes from indirect and natural changes

23

Summary of Session

- The international effort to address climate change is 10 years old, but important decisions are still being negotiated.
- Decisions at The Hague and Marrakech are important for carbon sequestration projects and national accounting.
- There are still many important issues to be decided. The IPCC will issue important studies, and COP will establish rules that will be important for both national and project action on sinks.

24

For Further Information

- For current information on the negotiations, meetings, special studies, and decisions for implementing the UNFCCC, see http://www.unfccc.int

25

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 2: Technical Issues in National Sinks Accounting

1. Overview

General Objectives: Session 2 will introduce students to some of the technical issues that have been discussed in relation to the national accounting of carbon sinks under the Kyoto Protocol. It will provide a brief discussion of the findings of the IPCC Special Report on Land Use, Land Use Change, and Forestry, as well as the impact of recent decisions affecting carbon sequestration. Decisions made at the most recent meetings of the Conference of Parties (COP) will be included.

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 60 minutes

Materials: Set of 20 PowerPoint charts

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

2. Reading and Resources

- Draft decision CP 6, available from www.unfccc.int. (Go to Resources, then Official Documents, then COP6, second session, then report FCCC/CP/2001/L.11/Rev.1.
- IPCC Special Report on Land Use, Land-Use Change, and Forestry, available from www.grida.no/climate/land_use/

Technical Issues in National Sinks Accounting

Session 2

Module 9: Carbon Sequestration by Forestry and Agriculture

1

Status of Technical Issues

- Scientific and technical issues were discussed in the IPCC Special Report on Land Use, Land-use Change, and Forestry.
- In Bonn, the COP draft decision covered many of these issues, mostly for the first commitment period (2008-2012)
- In Marrakech, COP considered the draft and accepted the Bonn draft as final.
- Some issues have been referred to the IPCC for further study and future decisions.

2

Technical Issues

- Definitions
  - Forest
    - (biome-specific in the future?)
  - Afforestation
  - Reforestation
  - Deforestation
    - Degredation
    - Devegetation
  - Eligible Activity (under Article 3.4)

3

Forest

- Draft Decision in Bonn (Now Final) -
  - Minimum area 0.05 to 1.0 hectares
  - Tree crown cover of more than 10-30 percent
  - Tree potential height of 2-5 metres
  - Includes young stands with potential to reach the above minimums, and areas temporarily unstocked due to harvest or natural causes.
- Each Party to select one single value for area, crown cover, and height prior to first commitment period.

4

For the Future

- COP has asked that consideration be given to biome-specific forest definitions that might be used in the second and future commitment periods.
  – This could provide definitions that recognize differences in boreal, temperate, and tropical forest structures.
  – The decision on this issue will be some years in the future.

5

Afforestation/Reforestation

- Direct, human-induced conversion of non-forested land through planting, seeding, or promotion of natural seed sources.
  – Afforestation – limited to land that has not been in forest for at least 50 years
  – Reforestation – former forest land that has been converted for less time. For first commitment period, land that was not forest on December 31, 1989.

6

Deforestation

- The direct human-induced conversion of forested land to non-forested land.
- Two related definitions need to be developed by IPCC and considered by COP:
  - Degradation – where forest cover may be seriously reduced, but not fall below the selected minimum crown cover (e.g. from 100% to 35%)
  - Devegetation – where another cover type (e.g. grazing land) is converted to cultivation.

7

Activities Eligible under Article 3.4

- Revegetation
  - The direct human-induced establishment of vegetation that covers a minimum area of 0,5 ha. (not afforestation or reforestation.)
    - e.g. cropland to grassland
  - Devegetation would be the reverse activity

8

Activities Eligible under Article 3.4

- Forest Management
  - A system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner.

9

Activities Eligible under Article 3.4

- Cropland Management
  - A system of practices on land on which agricultural crops are grown and on land that is set aside or temporarily not being used for crop production.
- Grazing land management
  - A system of practices on land used for livestock production aimed at manipulating the amount and type of vegetation and livestock produced.

10

Technical Issues

- Accounting Issues
  - Pools to be measured
  - Direct human-induced
  - Spatial units
  - Time to begin accounting
  - Continuous geographic accounting
  - Special rules for first commitment period (2008-2012)

11

Pools to be Measured

- Each Party included in Annex I shall account for all changes in **above-ground biomass, below-ground biomass, litter, dead wood, and soil organic matter**.
- A Party may choose not to account for a given pool in a commitment period, if transparent and verifiable information is provided that the pool is not a source.

12

Direct human-induced

- The accounting is limited to those changes in removals or emissions caused by direct human-induced activities.
  - e.g. forest management. A managed forest may increase significantly in biomass over 5 years. That increase (carbon sink) may be caused by the combined effect of 3 factors:
    - Direct human action (e.g. fertilizing the forest)
    - Indirect human action (e.g. airborne nitrogen from an industrial region)
    - Natural factors such as the age structure of the forest (e.g. if a country's forest is primarily young, it will be growing faster than if it were largely old growth.)
- For the first commitment period, COP established an 85% discount to eliminate natural and indirect factors, and a 3% cap on forest management.

13

Spatial Units

- In accounting for deforestation under Article 3.3, each Party shall use the same spatial assessment unit as is used for determination of afforestation and reforestation, but not larger than 1 hectare.

14

Time to begin accounting

- Accounting of the GHG emissions or sinks under Articles 3.3 and 3.4 shall begin with the onset of the activity or the beginning of the commitment period, whichever comes later.

15

Continuous Geographic Accounting

- Once land is accounted for under Articles 3.3 and 3.4, all anthropogenic greenhouse gas emissions by sources and removals by sinks on this land must be accounted for throughout subsequent and contiguous commitment periods.
- The land areas must be identifiable, with information provided by the Parties in their national inventories.

16

The First Commitment Period

- The First CP runs from 1 Jan 2008 to 31 Dec 2012.
  - Since the Annex I Parties made commitments before all definitions and accounting rules were established, some of the most scientifically-credible methods for the long term may produce unintended results in the First CP.
  - Special rules have been established to minimize such outcomes.

17

Technical Issues

- Assigned to future study and decisions
  - Additional changes to the IPCC 1996 Guidelines
  - "Good Practice Guidance and Uncertainty Management"
  - Definitions of degradation and devegetation
  - Practical methods for separating "Direct" vs. "Indirect" human-induced change
  - Accounting for Harvested wood products

18

Summary of Session 2

- The recent meetings of the COP have resulted in important decisions on definitions, accounting, and future studies.
- These decisions will allow Parties to begin work on the accounting strategies they will use for the first commitment period (2008-2012).

19

For Further Information

- Draft decision -/CP.6, available from www.unfccc.int. (Go to Resources, then Official Documents, then COP6, second session, then report FCCC/CP/2001/L.11/Rev.1.
- IPCC Special Report on Land Use, Land-Use Change, and Forestry, available from www.grida.no/climate/land_use/

20

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 3: Carbon Dynamics in Agricultural and Forestry Systems

1. Overview

General Objectives: Session 3 will introduce participants to the technical aspects of carbon flows in agricultural soils and forests. By the end of the session, participants will be familiar with the terms and concepts used in describing, estimating, and measuring carbon pools, stocks, and flows in agricultural soils, grazing lands, and forests.

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 60 minutes

Materials: Set of 27 PowerPoint charts

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

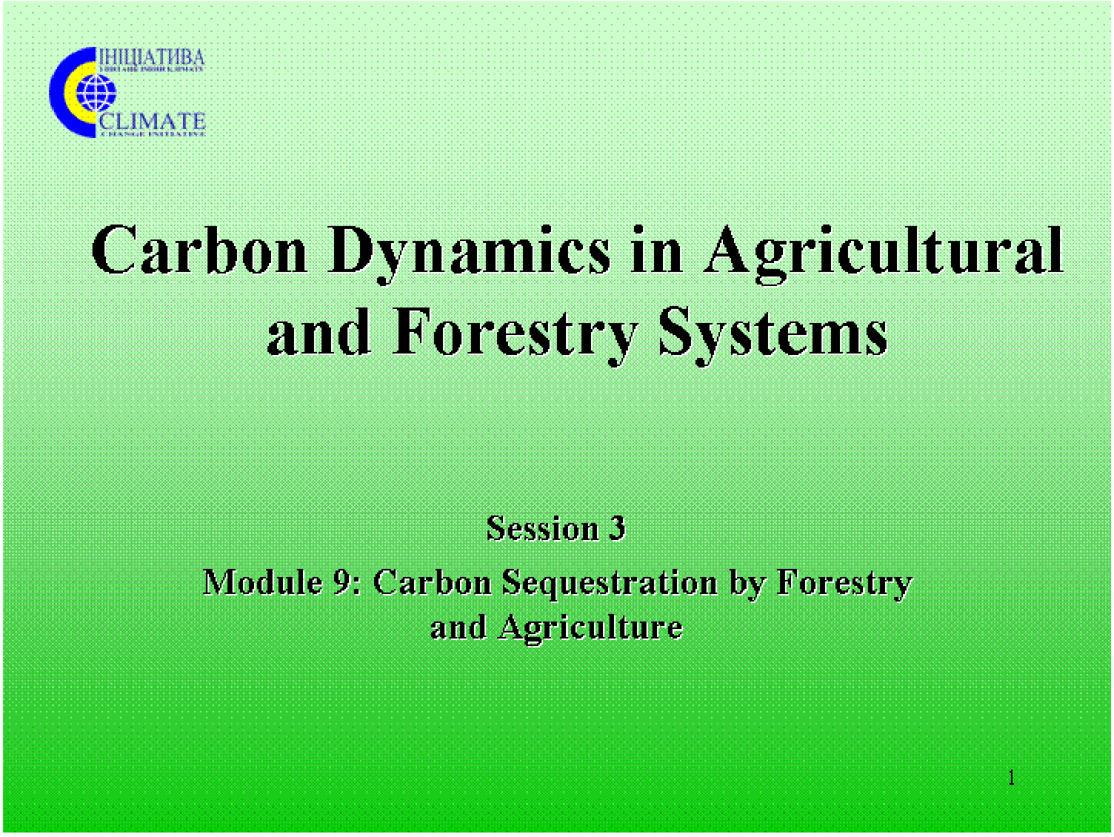
2. Reading and Resources

Birdsey, Richard A. 1992. *Carbon Storage and Accumulation in United States Forest Ecosystems.* Washington: USDA Forest Service: Gen Tech Rep WO-59. 51 pp.

Birdsey, Richard A. (1996). Carbon Storage in United States Forests, in R. Neil Sampson and Dwight Hair (eds), *Forests and Global Change, Volume II: Opportunities for Improving Forest Management*, Washington, DC: American Forests.

Lal R., J.M. Kimble, R.F. Follett, and B.A. Stewart (eds). 2001. *Assessment Methods for Soil Carbon*. Boca Raton, FL: Lewis Publishers. 676 pp.

Lal, R., J.M. Kimble, R.F. Follett and C.V. Cole (eds) 1998. *The Potential of U.S. Cropland to Sequester Carbon and Mitigate the Greenhouse Effect.* Chelsea, MI: Ann Arbor Press.128 pp.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CLIMATE
Carbon Dynamics in Agricultural and Forestry Systems
Session 3
Module 9: Carbon Sequestration by Forestry and Agriculture
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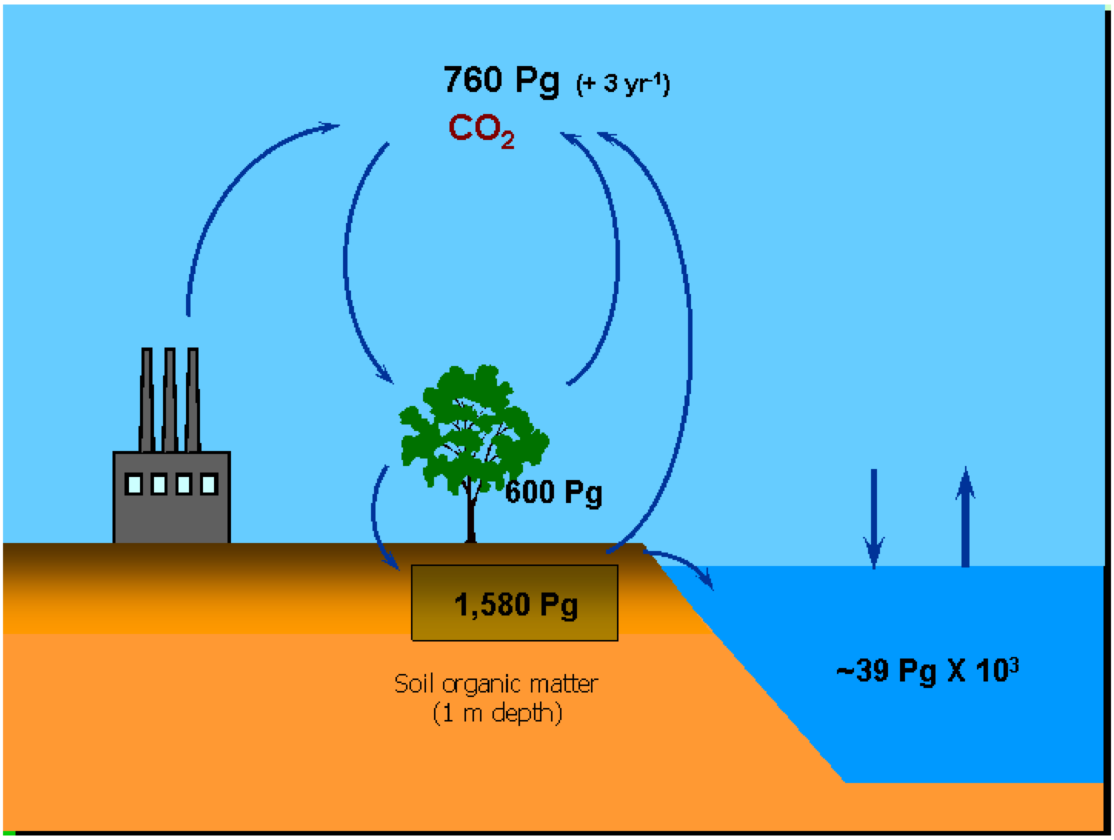

760 Pg (+ 3 yr-1)
CO2
600 Pg
1,580 Pg
Soil organic matter
(1 m depth)
~39 Pg X 10³

Comparing Units

Measure	English	Metric	Comparison
Area	Acre (ac)	Hectare (ha)	ha = 2,47 ac
Weight	Ton (t)	Tonne (t)	t(E) = 0,91t
Length	Foot (ft) Yard (y) Mile (m)	Centimeter (cm) Meter (m) Kilometer (km)	1 cm = 0,033 ft 1 m = 1,09 y 1 km = 0,62 m

3

Very Large Units

Name	Abbreviation	Grams	Tonnes
Tonne	T	10^6	1
Megaton Teragram Million Metric Tonnes	Mt Tg MMT	10^{12}	10^6
Gigaton Petagram	Gt Pg	10^{15}	10^9

4

Terms used in this session

- Carbon Pool – A system that has the capacity to accumulate or release carbon, such as:
  - Forest biomass
  - Wood products
  - Soils
  - Oceans
  - Atmosphere

5

Terms used in this session

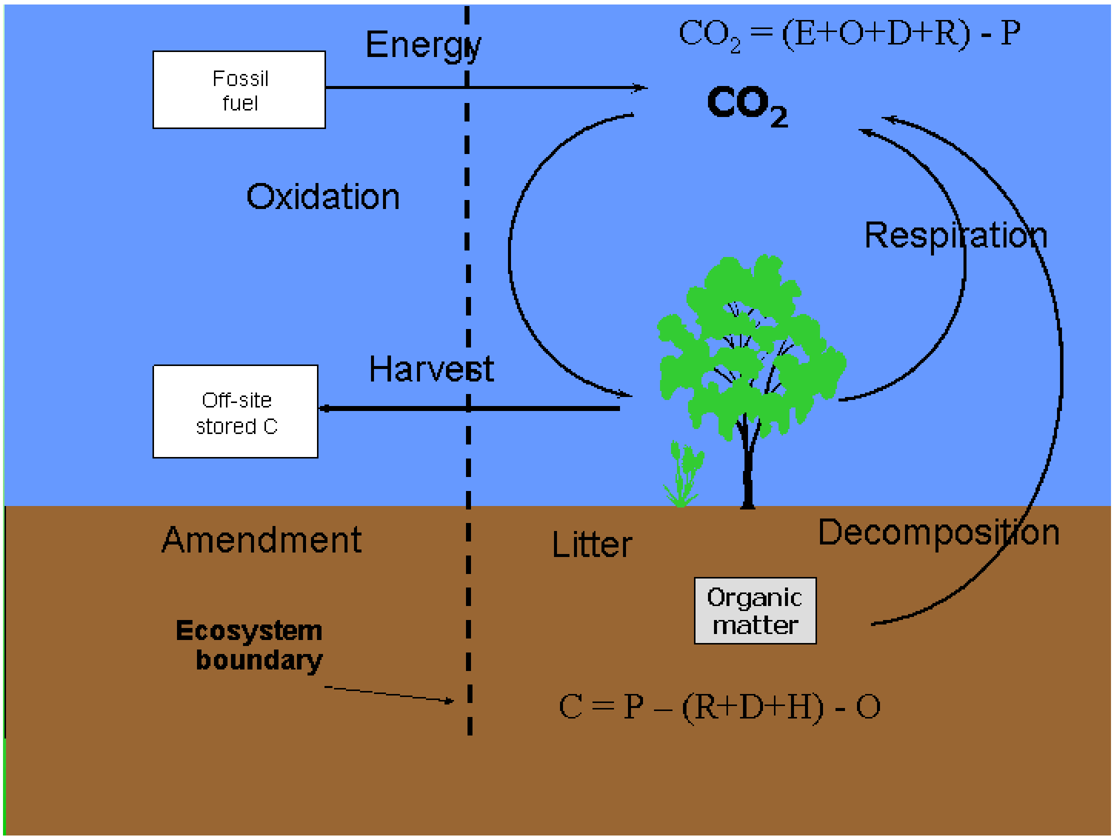
- Carbon Stock – The absolute quantity of carbon held within a pool at a specific time. Measured as mass (e.g. tC or tC/ha)
- Carbon Flux or Flow – Transfer of carbon from one carbon pool to another. Measured in units of mass per unit area and time (e.g. tC/ha/yr)

6

Terms used in this session

- Sequestration – The process of increasing the carbon content of a carbon pool other than the atmosphere.
- SOM – Soil organic matter (e.g. humus). Does not include soil biomass (roots, bulbs, etc.) or soil fauna (Insects, worms, other animals)
- SOC – Soil organic carbon – the carbon content of SOM (~ 58% of SOM)
- SIC – Soil inorganic carbon (e.g. $CaCO_3$, charcoal)

7



Note on Units of Weight

- When Carbon is in the atmosphere, it is in the form of Carbon Dioxide (CO_2).
- When it is in the biosphere, we usually express it in terms of elemental Carbon (C).
- The molecular weights are C=12 and CO_2=44. Therefore 1 tonne of C is the equivalent of 3.67 tonnes of CO_2.
- This can cause confusion. Be alert as to which form is being described!!

9

Soil Organic Matter

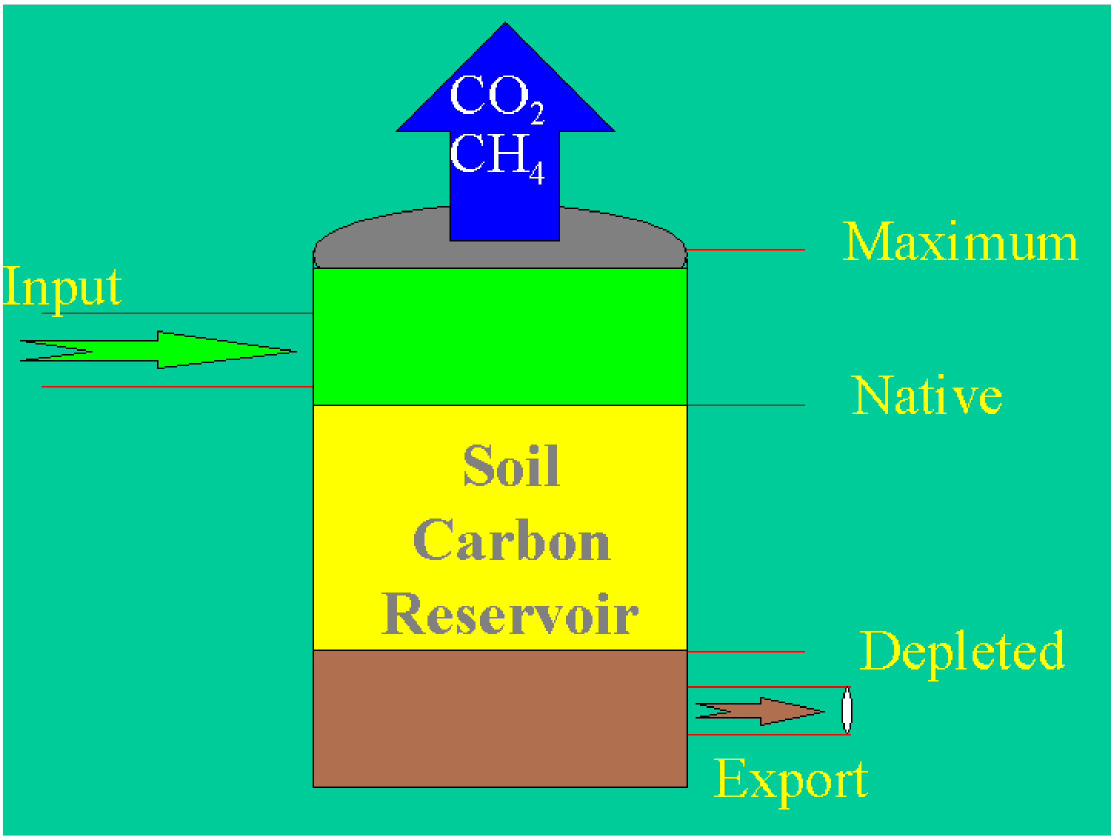
- Soil Organic Matter provides the energy source for biological activity in the soil.
- SOM is also critical for:
  - Soil structure – stabilizing soil aggregates
  - Moisture holding capacity
  - Cation exchange capacity – plant nutrition
- **SOM is ~ 58% carbon**

10

Soil Organic Carbon

- The amount of SOC in any soil at any time is a product of:
  - The amount of new carbon being introduced through plant roots, leaves, insects, earthworms, etc.
  - The amount of carbon leaving the soil due to biological respiration, leaching, methane production, or soil erosion.
- Thus, SOC levels are regulated by:
  - Type of vegetation (bare, crops, grass, trees)
  - Climate (moisture, temperature) (temperate, tropical)
  - Management (disturbance, aeration, cover)

11



Loss of Soil Carbon

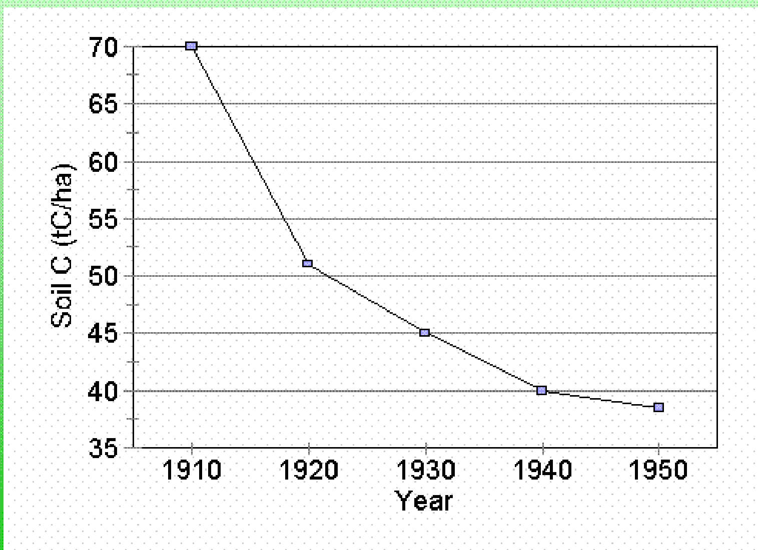
- Shifting Land Use
  - Grass or trees to crops or development
- Cultivation
  - Increased aeration
  - Increased soil temperature
- Soil Erosion
  - Carbon Transport
  - Lower Productivity

13

Loss of Soil Carbon

Simulated C loss from cultivating grassland soils.

Adapted from Lal et al. (1998)

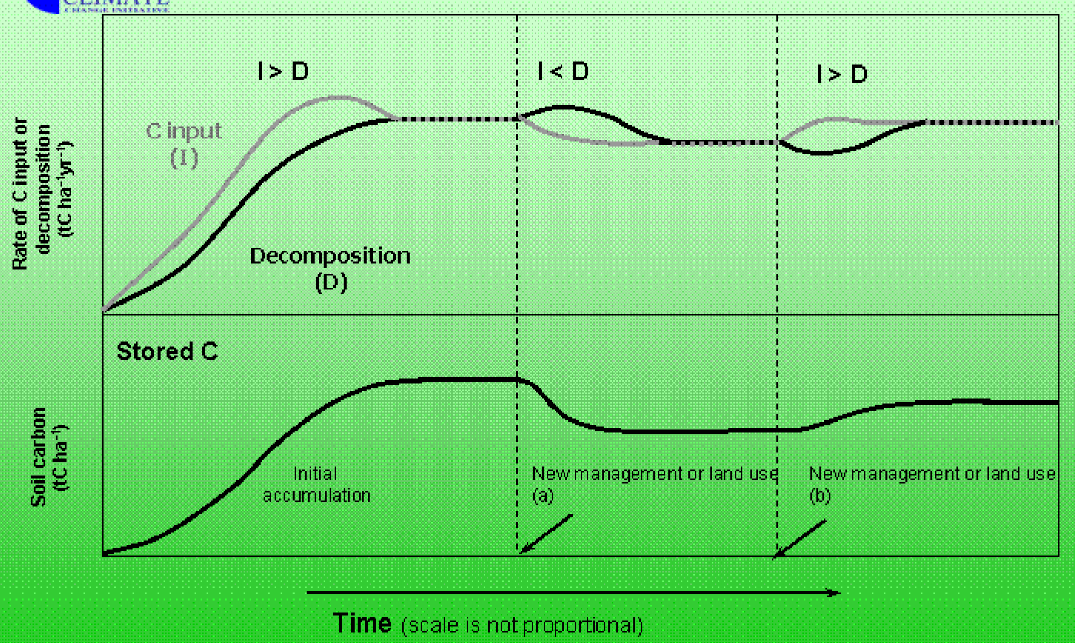


14

Increasing Soil Carbon Pool

- Increase organic matter inputs, roots, litter
- Reduce cultivation, aeration
- Improve crop yields (fertilizer, manure, crop rotations)
- Improve water management
- **Improved carbon management in agricultural soils improves soil quality.**

15

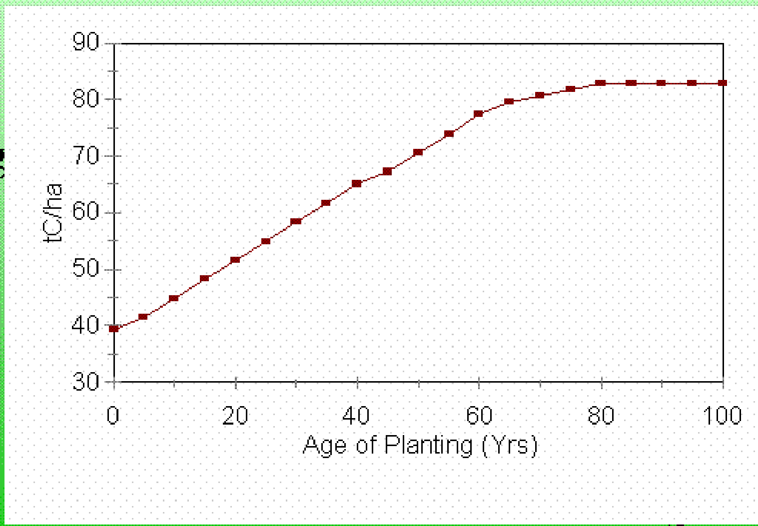


16

Increasing Soil Carbon with trees

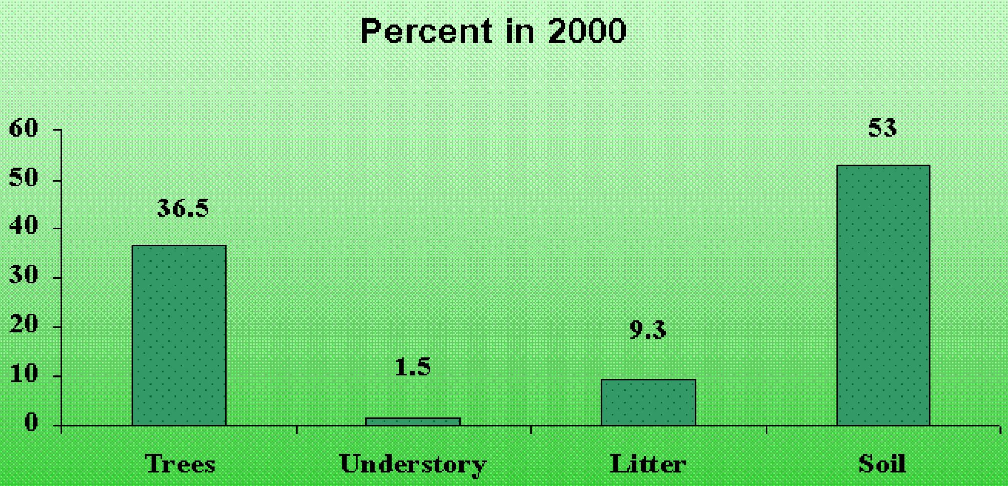
Increase in soil carbon from planting pine trees on depleted cropland.

Adapted from Birdsey, 1996.



17

Carbon Storage in U.S. Forests



18

Increasing Forest Carbon Pools

- Wood Pools on the land
  - Increase forest area through afforestation
  - Grow well-adapted tree species and cultivars
  - Improve management to increase standing biomass
  - Protect from conversion, fire, insects, disease, etc.
- Wood Pools in use
  - Use wood products instead of steel, etc.
  - Extend product life

19

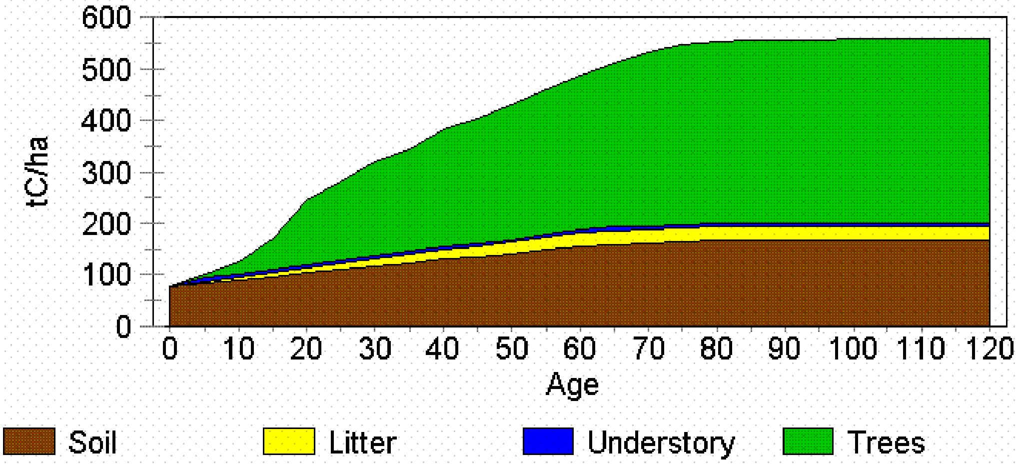
Biofuels

- Increase use of wood for energy
  - Use wood and paper waste for biofuel
    - Co-generation plants in forest industry
  - Use waste wood (thinnings, branches, etc.) from forest management activities.
  - Grow fast-growing wood crops like hybrid poplar for biofuel.

20

Southern Pine (U.S)

Cropland, Site 79+



21

Carbon Conversion Factors

Species	Specific Gravity	Percent Carbon	Multiply to Whole Tree
Pine	0,47	0,531	1.682
Oak	0,61	0,498	2,418
Beech	0,58	0,498	2,418
Birch	0,46	0,498	2,418
Fir	0,35	0,512	2,254
Spruce	0,43	0,512	1,675

Source: Birdsey , Richard A. 1996. Carbon Storage for Major Forest Types and Regions in the Conterminous United States, Tables 1.1 to 1.3, in Sampson, R.Neil and Dwight Hair. 1996. Forests and Global Change, Volume 2. Washington, DC: American Forests

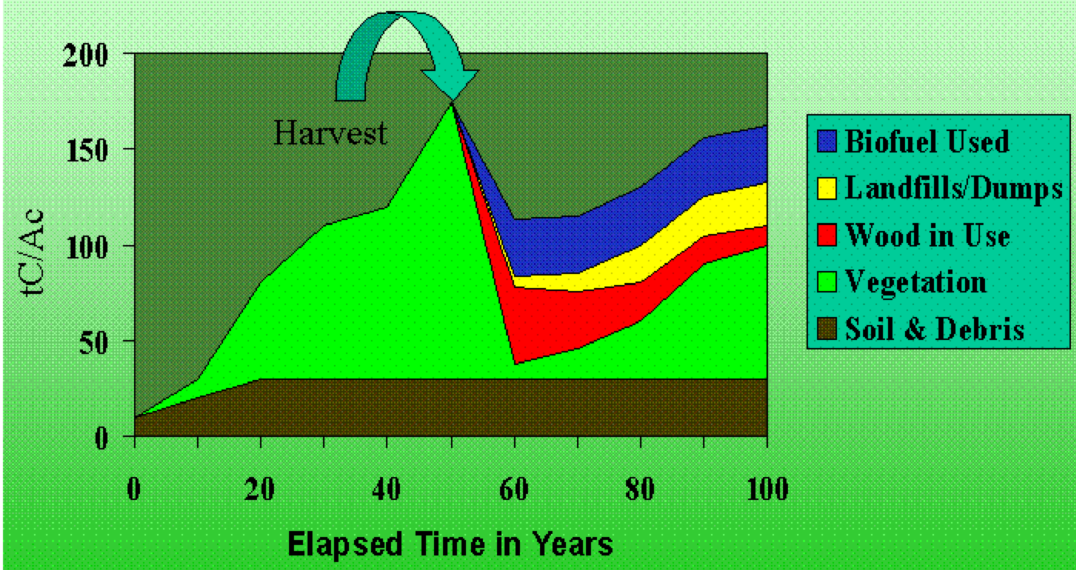
22

Convert Wood Yield to Carbon

- Example – Scots Pine (using U.S. factors for conversion with yields from Ukrainian tables.)
  - Yield at 50 years = 353 M^3 wood per hectare
  - Dry weight = 353 x 0,47 = 166 tons wood per hectare
  - Whole tree (roots, etc.) = 166 x 1.682 = 279 t/ha
  - Carbon = 279 x 0,531 = 148 tC/ha

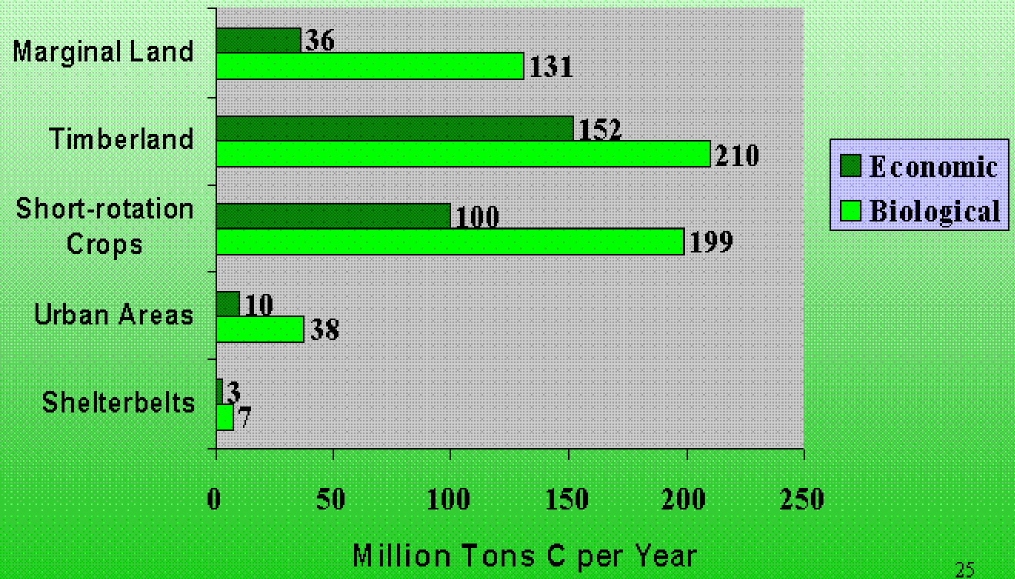
23

Carbon Flows – Pine Forest SE United States



24

Forestry Opportunities in the U.S. to Increase Carbon Storage and Reduce Emissions



25

Summary of Session 3

- Need to understand technical terms and concepts used in discussing carbon.
- Importance of soil carbon in maintaining productive ecosystems
- Methods of converting standard forestry data into carbon estimates
- There are many opportunities to improve agricultural and forest management that will result in carbon sequestration.

26

Further Information

- Birdsey, Richard A. 1992. *Carbon Storage and Accumulation in United States Forest Ecosystems.* Washington: USDA Forest Service: Gen Tech Rep WO-59. 51 pp.
- Birdsey, Richard A. (1996). Carbon Storage in United States Forests, in R. Neil Sampson and Dwight Hair (eds), *Forests and Global Change, Volume II: Opportunities for Improving Forest Management*, Washington, DC: American Forests.
- Lal R., J.M. Kimble, R.F. Follett, and B.A. Stewart (eds). 2001. *Assessment Methods for Soil Carbon*. Boca Raton, FL: Lewis Publishers. 676 pp.
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27

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 4: Potential of Carbon Sequestration by Ukraine's Forests

1. Overview

General Objectives: Session 4 will introduce participants to the potential of carbon sequestration by Ukraine's forests.

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 45 minutes

Materials: Set of 14 PowerPoint slides

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

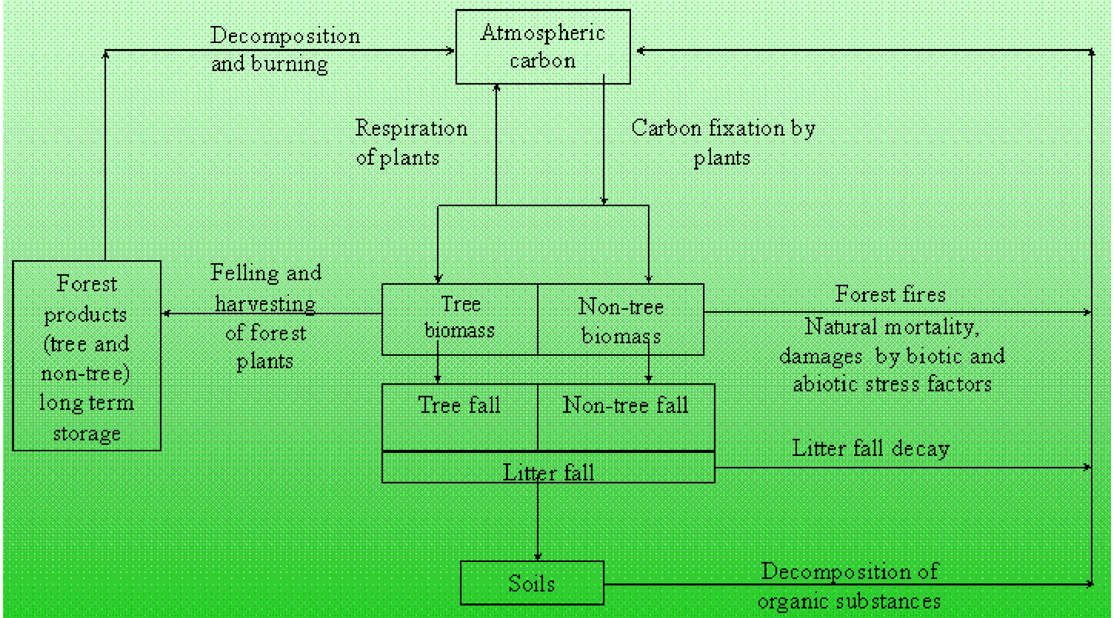
POTENTIAL OF CARBON SEQUESTRATION BY UKRAINE'S FORESTS

Session 4

Module 9: Carbon Sequestration by Forestry and Agriculture

1

Carbon Cycle in Forest Ecosystem



2

Carbon Pools of Forest Ecosystems:

FOREST VEGETATION:

TREES (LIVING AND DEAD),
SEEDLINGS AND SAPLINGS,
UNDERSTORY

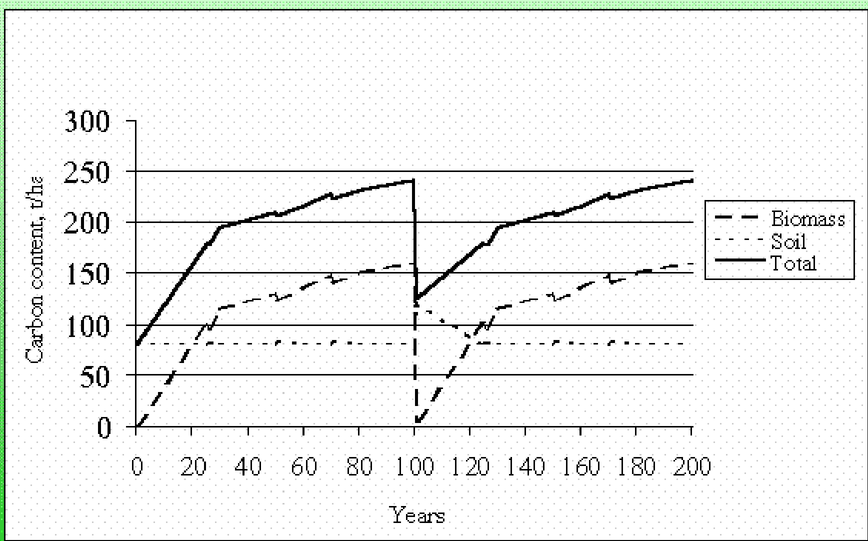
FALL AND LITTERFALL

FALLEN TREES

SOILS

3

Carbon Dynamics in Forest Plantation (Final Felling in 100 Years)



4

Carbon Content in Treefall and Litter Fall in Middle-Aged Stands*

Indicator	Pine	Oak
Annual fall, t/ha	3-5	4-6
Forest litterfall reserves, t/ha	10-12	11-14
Carbon stock in litterfall, t/ha	0.2-0.25	0.2-0.3
Annual fall in terms of carbon, t/ha	0.8-1.2	1.1-1.7
Carbon emission into atmosphere due to decomposition of litterfall, t/ha per year	0.5-4.5	1.0-5.0

*Source: UkrNDILGA

5

Humus and Carbon Stocks in 1 m of Forest Soil Depth, t/ha*

Soils	Humus stocks	C (carbon)
Soddy-podzolic soil	80-100	46-58
Gray forest soil	200-300	116-174
Ordinary black soil	400-500	232-290

*Source: UkrNDILGA

6

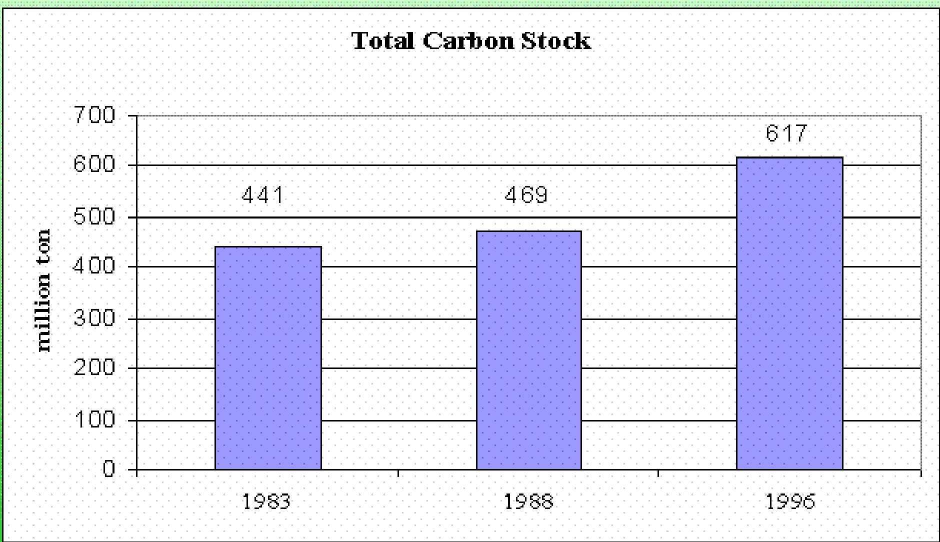
Dynamics of Ukraine's Forest Fund Indicators and Average Carbon Stock per 1 ha*

Indicators	1983	1988	1996
Forest land, thou.ha	8588	8620.6	9400.2
Total stock, million m^3	1239.70	1319.87	1736.02
Average stock, m^3/ha	144	152	186
Average carbon content, t/ha	51	54	66

*Sources: Brief reference book on forest fund of Ukraine, 1996;
Lakida P.I., 1997.

7

Dynamics of Carbon Content in Phytomass of Ukraine's Forests Due to Change in Age Structure and Forests Area*



*Source: Brief reference book on forest fund of Ukraine

8

Logging and Carbon Removal in Forests of the State Forestry Committee of Ukraine*

Indicators	1983	1987	1996
Total trees felled, thou. m^3	15360.2	14915	11171
Including:			
Merchantable wood and commercial raw materials, thou. m^3	6732.4	6448.0	5298.8
Firewood, thou. m^3	8065.2	8020.0	5372.0
Waste wood, thou. m^3	562.6	447.0	500.2
Carbon content in felled wood, thou. tons	3686	3580	2681

*Source: Statistical Accounting of the State Forestry Committee of Ukraine

9

Dynamics of Reforestation and Afforestation in Ukraine, thou. ha*

Indicators	Years			
	1990	1993	1996	1999
Reforestation in the State Forest Fund	35.4	26.8	30.5	29.9
Creation of ravine forests	17.2	11.2	11.6	5.9
Creation of shelter belts	4.5	2.0	2.1	0.4

*Source: National Report on the State of Environment in Ukraine

10

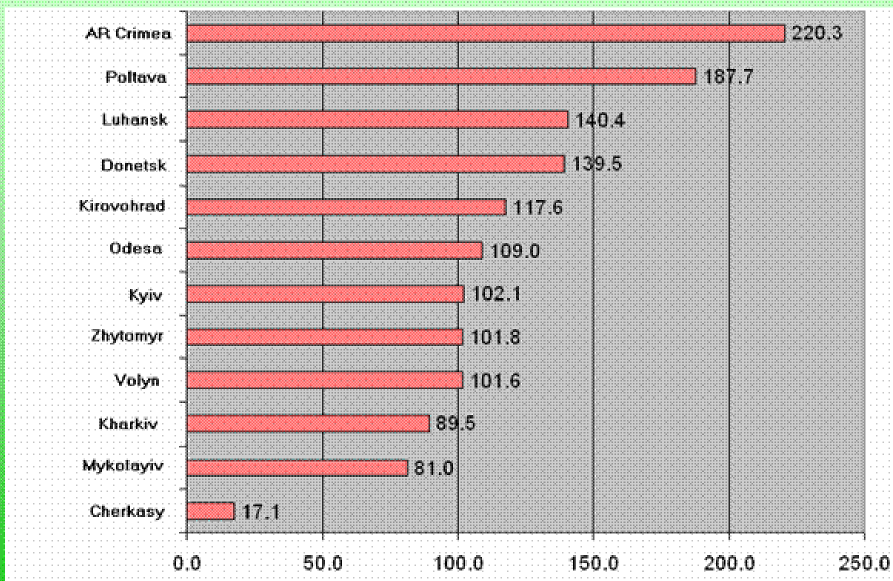
Areas Requiring Conversion from Plough-Land to Forest Lands or Meadows (according to Data of Ukrainian Academy of Agrarian Sciences, 2001)

Zone	Area, thou.ha
Steppe	4147
Forest-steppe	3090
Polissya and Carpathians	1392
Total for Ukraine	**8629**

*Source: State of land resources of Ukraine: problems and possible solution, 2001

11

Area of Afforestation for Achieve Optimal Percentage of Forest Cover in Some Regions, thou. ha



12

Planned Creation of Protective Forest Stands, thou.ha*

Regions	Total	2001-2005	2006-2010	2011-2015
Total for Ukraine	**299.5**	**87.9**	**99.9**	**111.6**
Including:				
Mykolayiv	**32.1**	12.2	9.4	10.5
Odesa	**31**	10	9.9	11.1
Zaporizhzhya	**30.4**	6.9	10.8	12.8
Dnipropetrovsk	**29.4**	7.5	10.3	11.6
Luhansk	**24.2**	9.2	7.6	7.4
Kharkiv	**15.7**	4	5.4	6.3
Kherson	**12.9**	4.3	4.3	4.4
Donetsk	**12.5**	3.7	4	4.7
Kirovohrad	**12.4**	4.2	3.9	4.3
Poltava	**10.8**	2.9	3.7	4.2

*Source: Resolution of the Cabinet of Ministers of Ukraine No 189 of 02.28.2001

13

Nature Conservation Aspect of reforestation and Afforestation:

- Using of natural forest renewal (appropriate felling system, promoted renewal).
- Creation of forest stands close to natural according to forest types (native seeds and seedlings for each region, proffering of indigenous species).
- Afforestation according to "The instructions on projecting, techniques, accounting and assessments of forest culture quality", Kyiv, 1998.

14


ІНІЦІАТИВА
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For Further Information:
• Laboratory of Forest Monitoring and Certification, URIFFM, 86 Pushkin Str., Kharkiv 61024, phone:+80572 431549, fax:+80572 432520, e-mail: buksha@uriffm.com.ua
• Science and Information Department, State Forestry Committee of Ukraine, 5 Khreshchatik Str., Kyiv 01601, phone:+8044 2287858, fax:+8044 2296007, e-mail: dklg@nbi.com.ua
15

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 5: Monitoring, Evaluation and Verification of Carbon Sequestration by Forests of Ukraine

1. Overview

General Objectives: Session 5 will introduce participants to the technical aspects of monitoring, evaluation and verification of carbon sequestration by forest of Ukraine. By the end of the session, participants will be familiar with specific techniques and methodologies available.

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 30 minutes

Materials: Set of 20 PowerPoint slids

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

Monitoring, Evaluation and Verification of Carbon Sequestration by Forests of Ukraine

Session 5

Module 9: Carbon Sequestration by Forestry and Agriculture

1

Entities Involved in Monitoring of Ukrainian Forests

Information on the state of forest resources of Ukraine is collected on a regular basis by:

- **PA "Ukrderzhlisproekt", "Ukrlisozachist"**: ***activity:*** forest inventory, ***level:*** national (forest fund of the country), ***methods of data collection:*** predominantly visual and instrumental measurements.
- **Forestry research institutions**: ***activity:*** researches and implementation of monitoring programs, ***level:*** national (part of forest fund of the country), ***methods of data collection:*** predominantly instrumental and visual measurements.
- **Forestry educational institutions: *activity:*** training and methodological activities, researches, ***level:*** local (individual forest areas) ***methods of data collection:*** predominantly visual and instrumental measurements.

2

Carbon Targets Monitored in Forests

- area of forest;
- dynamics of plant biomass (stand increment and mortality);
- dynamics of carbon content in soils, fall and litter fall.

3

Data Sources for Evaluation of Carbon Sequestration by Ukraine's Forests

- ***Materials of forest inventory***: dynamics of forested lands and wood stocks determined according to standardized procedures (OST 56-69-83 Experimental Forest- Management Areas. Methods of Establishment);
- ***Monitoring programs and other special researches***: carbon content in various phytomass components of forests, forest soils, and dynamics of forested lands according to data of remote monitoring.

4

Ukraine's Forest Monitoring Program

The National Forest Monitoring Program is based on the multi-level principle of data collection (combines the extensive Level I observations and intensive Level II observations). These levels are consistent with two international forest monitoring programs:

- International Co-operative Program on Assessment and Monitoring of Air Pollution Effects on Forests operating under United Nations Economic Commission for Europe (UN/ECE ICP Forests)
- International Forest Health Monitoring Program under the US technology of Forest Health Monitoring (FHM)

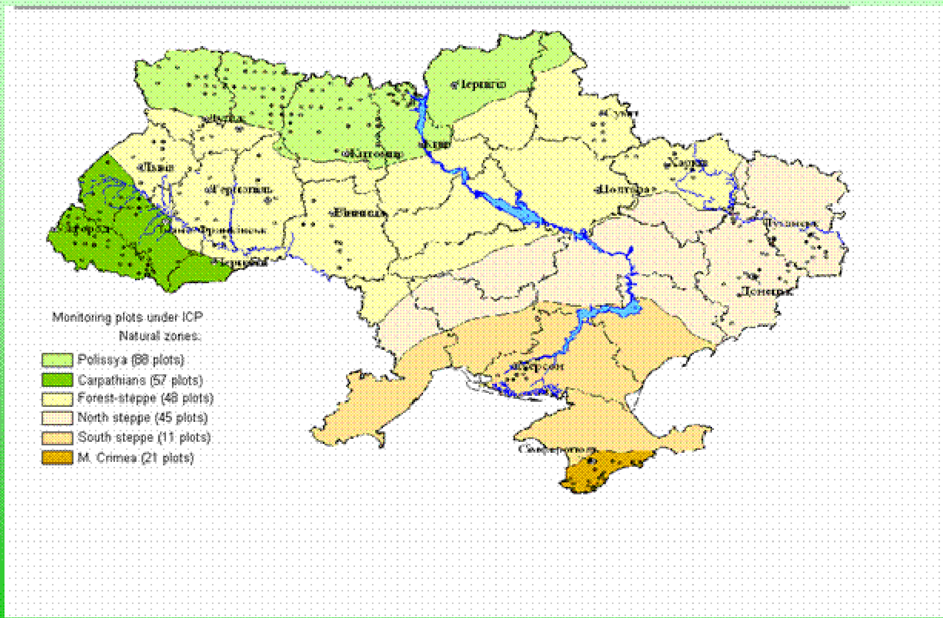
5

Forest Monitoring under Methodology of UN/ECE- ICP Forests

- It has been implemented by UkrNDILGA from 1989;
- 270 permanent monitoring plots in 16 oblasts and Autonomous Republic of the Crimea;
- Level I monitoring comprises indicator (detector) functions - informs of the worsening or improvement of the forest condition;
- annual observation are carried out in line with requirements of ICP Forests, Level I. Main task of Level I monitoring is to detect facts of changes in the forest conditions;
- main indicator – crown defoliation (leaf or needle loss) is a pan-European indicator of the forests sustainable development characterizing their vitality.

6

Grid of ICP FORESTS Monitoring Plots



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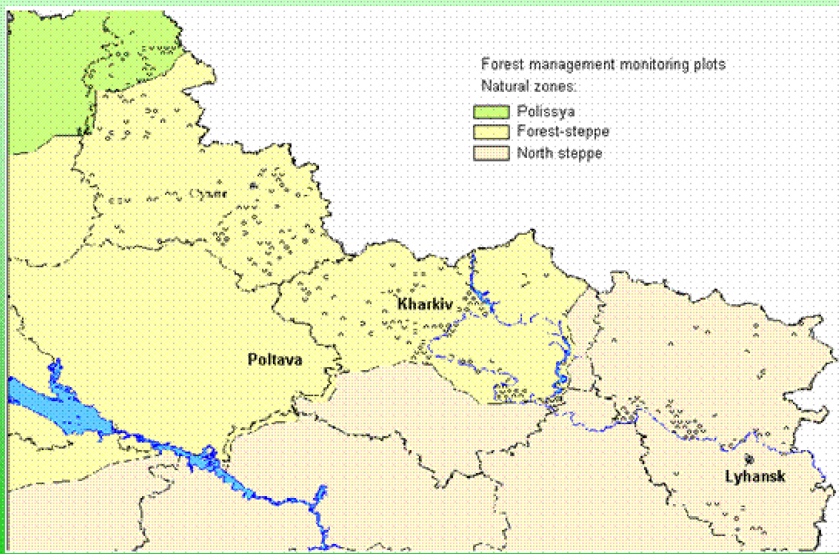
Forest Management Monitoring Pilot Project

- It is implemented by UkrNDILGA jointly with PA "Ukrderzhlisproekt";
- From 2000 it has been implemented in the territory of Luhansk, Sumy and Kharkiv oblasts, in 2001 monitoring zone is extended to another 4 oblasts;
- more than 300 permanent monitoring plots have been established
- observations are carried out according to the methodology harmonized with the requirements of ICP Forests, Level I.

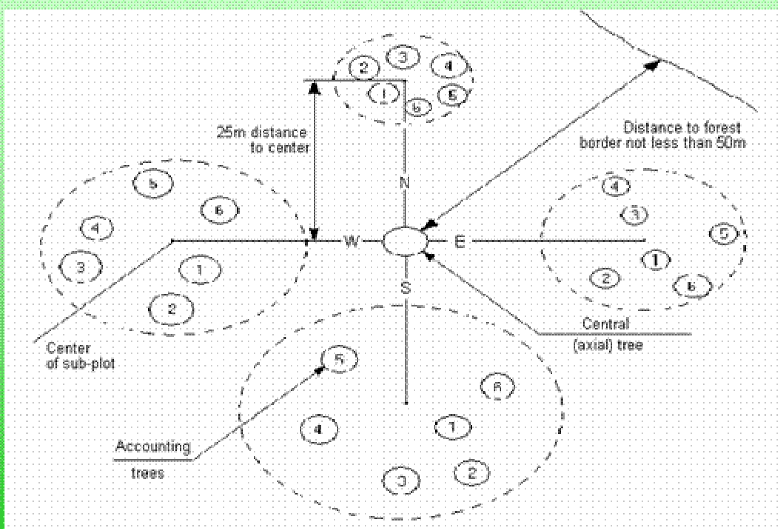
8

Grid of Forest Management Monitoring Plots



9

Scheme of ICP FORESTS Monitoring Plots



10

Possibility of Assessing Dynamics of Biomass and Carbon Accumulation in Forest Vegetation under ICP FORESTS, Level I

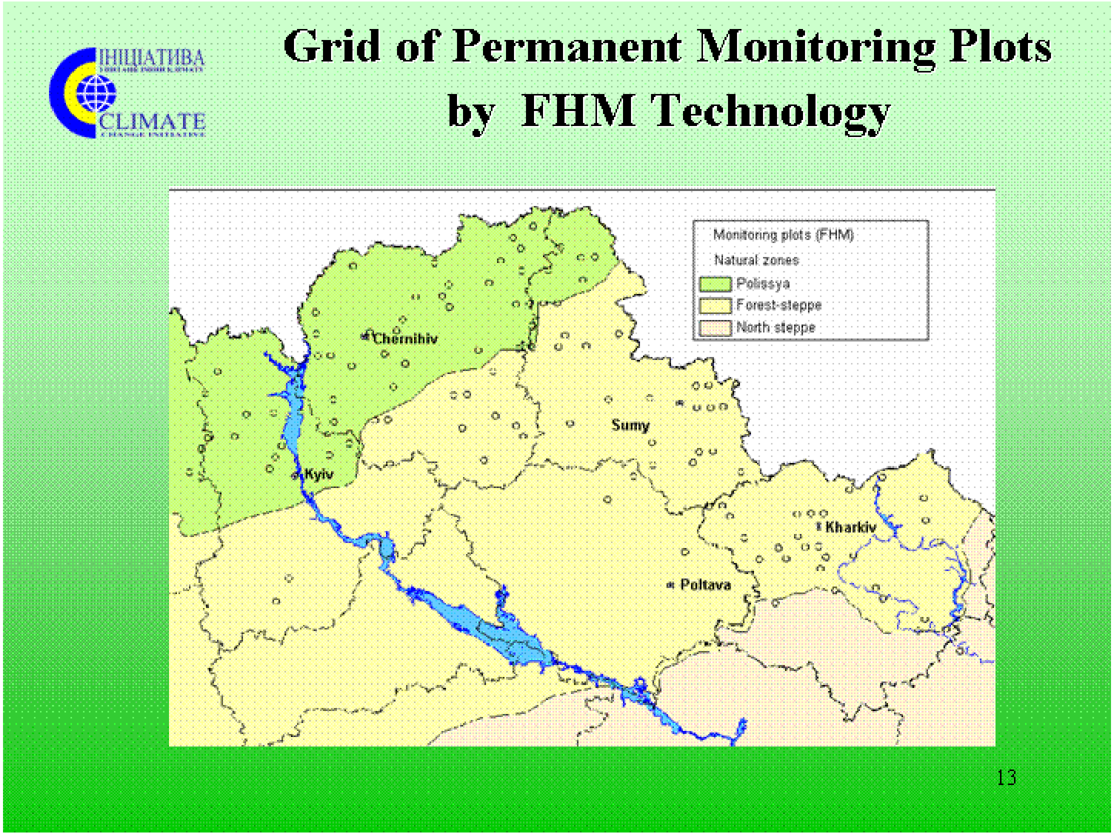
- On the monitoring plots the assessment is made for 24 trees of the I-III class according to the system of Kraft, for which a set of monitoring indicators, including tree height and their diameter at the height of 1.3 m, is defined;
- direct determination of dynamics of carbon accumulation in the plantation is problematic - the area of the Level I plots is not fixed, which complicates the possibility to determine the stock of the tree stand on the plot with a sufficient accuracy level;
- Possible is only an approximate determination of increment of tree stand biomass on the basis of correlation relations and calculations, on this basis, of carbon accumulation;
- accurate assessment of carbon sequestration on the Level I monitoring plots requires additional measurements.

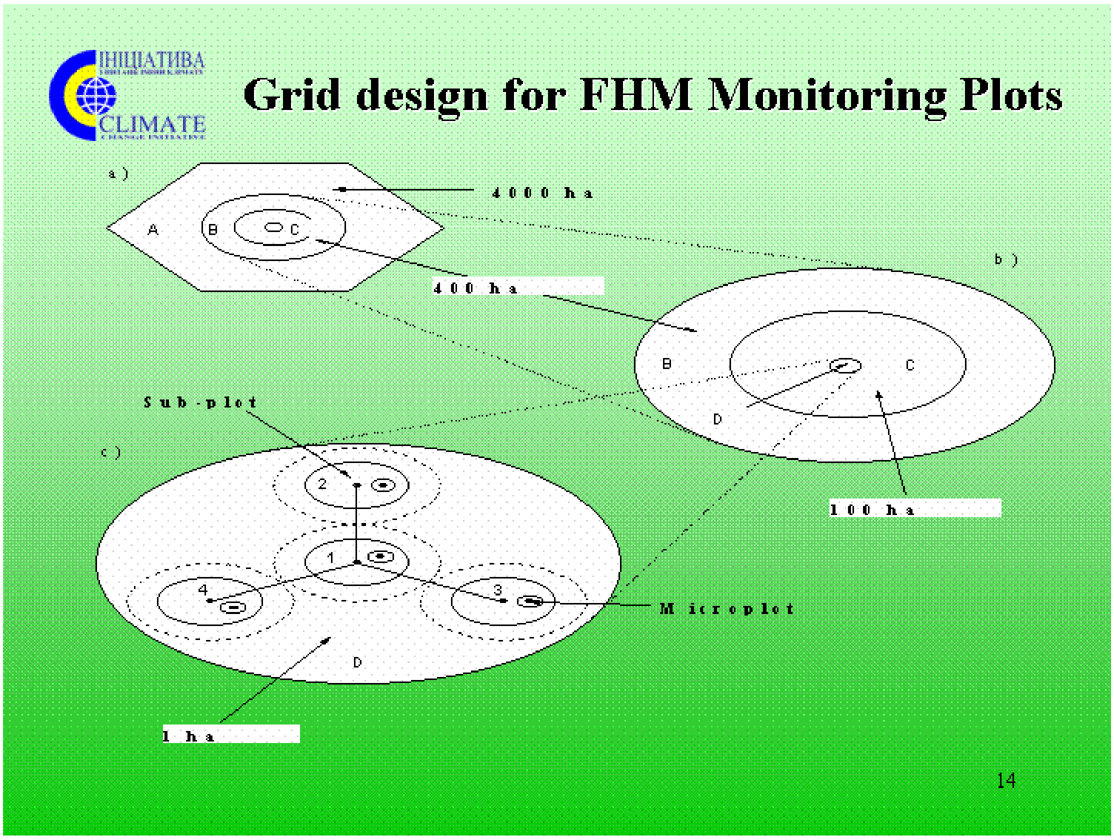
11

Forest Monitoring under Technology of USA International Program FHM

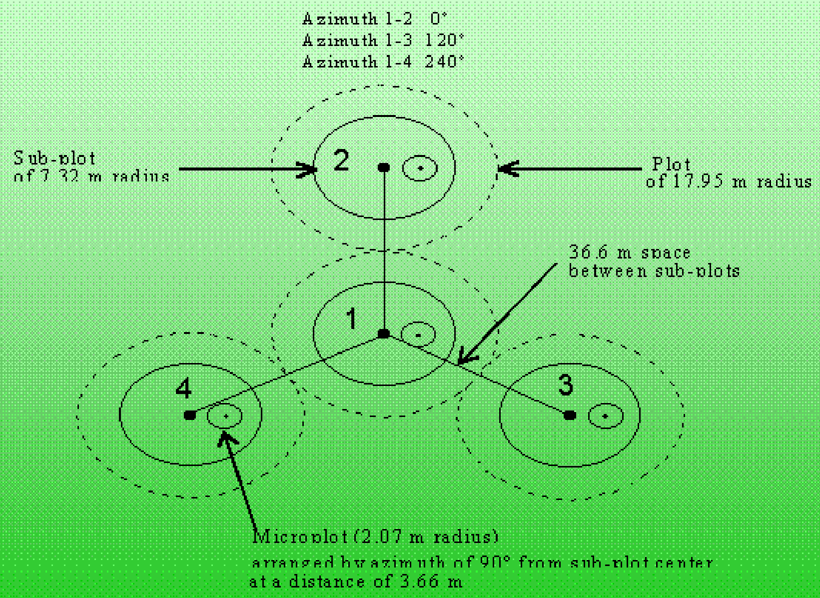
- It has been implemented by UkrNDILGA from 1995
- 120 permanent plots were established in the territory of 7 north-east oblasts of Ukraine
- Observations are carried out under the 4-year cycle
- Statistical design of plots grid, possibility for dense and random plotting of the grid
- Special field equipment to determine biometric indicators of forest vegetation and FAR
- Capability of direct determination of dynamics of carbon accumulation (accurate determination of forest plant biomass, instrumental assessment of FAR and leaf area indices)

12


Grid of Permanent Monitoring Plots
by FHM Technology
Monitoring plots (FHM)
Natural zones
Polissya
Forest-steppe
North steppe
Chernihiv
Sumy
Kyiv
Kharkiv
Poltava
13


Grid design for FHM Monitoring Plots
a)
4000 ha
A
B
C
400 ha
b)
B
C
D
Sub-plot
100 ha
c)
2
1
4
3
Microplot
D
1 ha
14

Scheme of FHM Monitoring Plot



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Potentials to Assess Dynamics of Forest Vegetation Biomass under FHM Technology

- determination of biometric indicators of all trees (diameter >12.7 cm) on the plots with fixed area;
- measurement of biometric parameters of understorey vegetation (saplings, undergrowth, lianas, ground vegetation layer, fallen trees, etc.);
- special sub-program of monitoring soils, fall and litterfall;
- FAR measurements

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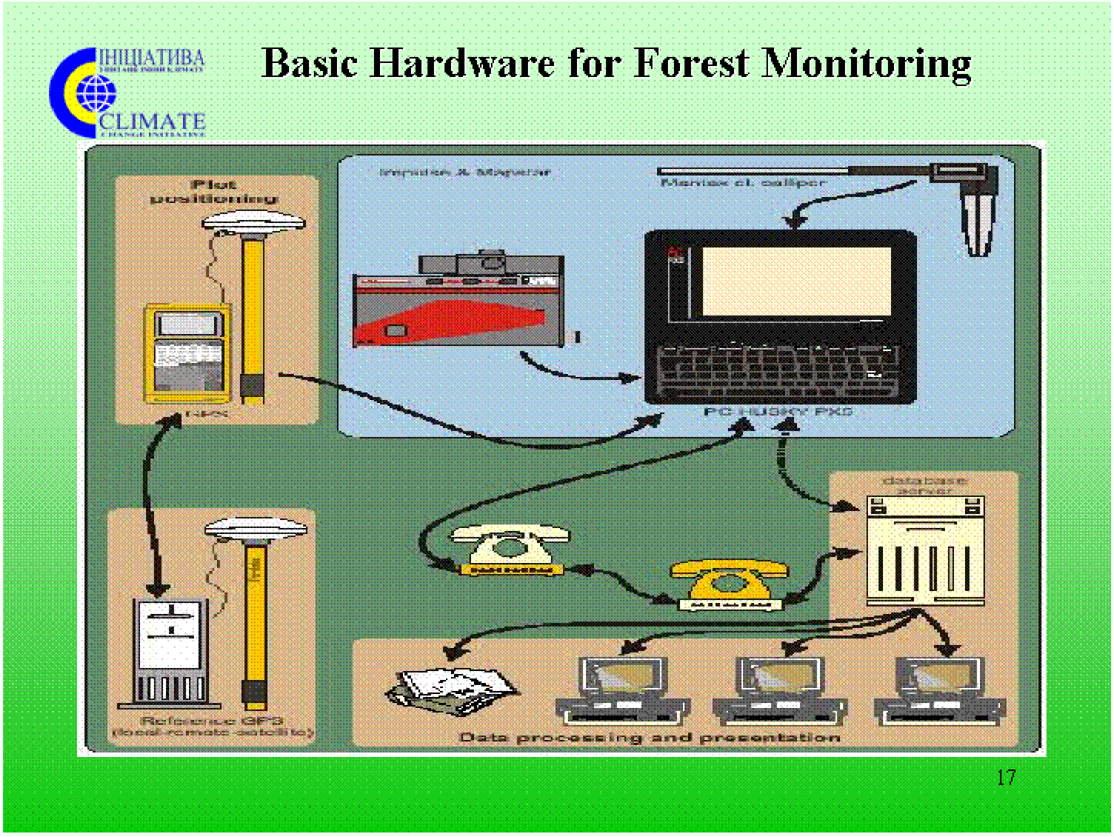
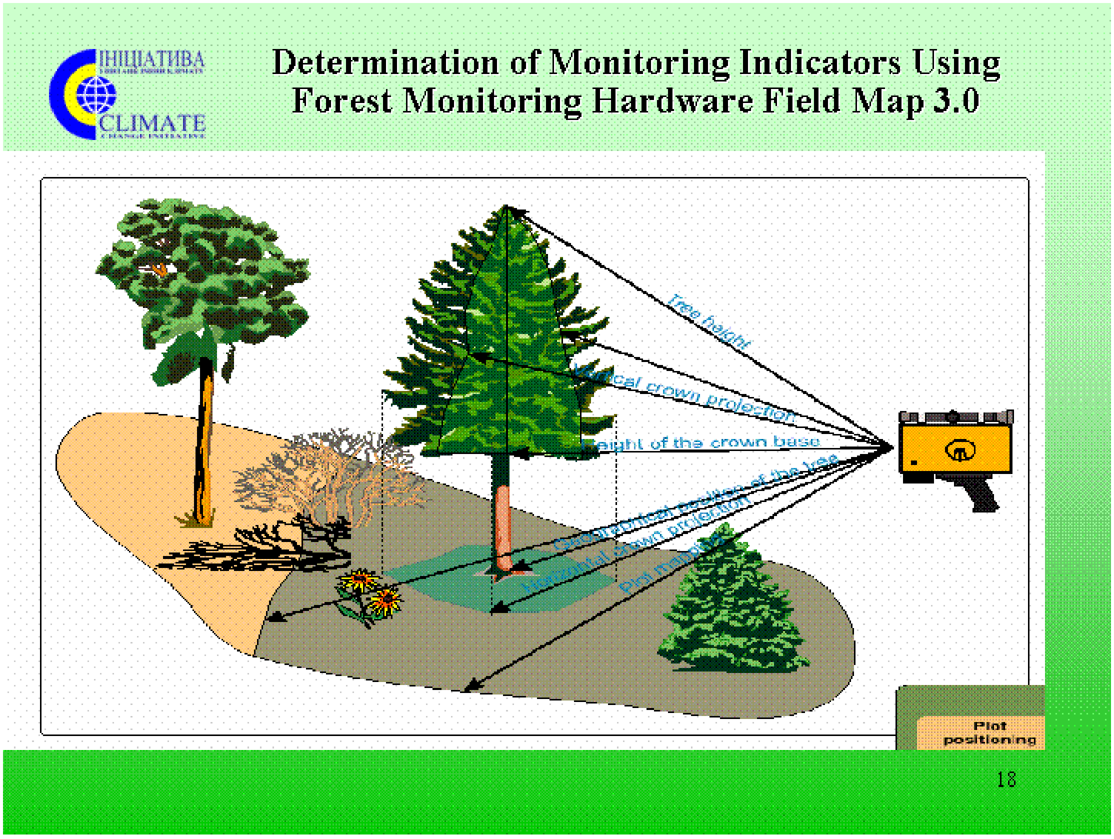

Basic Hardware for Forest Monitoring
Plot positioning
PC HUSKY FX5
database server
Reference GPS (local-remote-satellite)
Data processing and presentation
17


Determination of Monitoring Indicators Using Forest Monitoring Hardware Field Map 3.0
Tree height
Plot positioning
18

Technological Aspects of Assuring Carbon Sequestration Monitoring Quality

- application of remote monitoring methods (aerospace survey, radar measurements) and up-to-date devices (field computers, altimeters, range-finders, electronic calipers, sample cutters, drills, global positioning and mapping systems - GPS, etc.);
- application of international monitoring technologies (such as ICP Forests, FHM, Field Map 3.0);
- direct determination of carbon sequestration by forest ecosystems.

19

For Further Information:

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20

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 6: Issues in Project Development

1. Overview

General Objectives: Session 6 will introduce participants to some of the issues that have been important in the development of carbon sequestration projects. Firm guidelines for addressing these issues do not exist in most cases, but there has been a great deal of discussion that can provide guidance in the design and planning of projects. By the end of the session, participants should have a basic understanding of concepts such as additionality, leakage, and permanence, and be able to apply the concepts to situations with which they are familiar.

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: **60** minutes

Materials: Set of 22 PowerPoint charts

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

2. Reading and Resources

Hamburg, S.P. 2000. Simple rules for measuring changes in ecosystem carbon in forestry-offset projects. *Mitigation and Adaptation Strategies for Global Change*. 5:1, p. 25-37.

IPCC Special Report on Land Use, Land-Use Change, and Forestry (Chapter 5), available from www.grida.no/climate/land_use/

Woerdman, E. and W. van der Gaast. 2001. Project-based emissions trading: The impact of institutional arrangements on cost-effectiveness. *Mitigation and Adaptation Strategies for Global Change*. 6:2, p. 113-154.

Issues in Project Development

Session 6

Module 9: Carbon Sequestration by Forestry and Agriculture

1

Issues to Address

- Additionality
  - Baseline establishment
- Leakage
- Permanence
- Allocation of Carbon Credits
- Monitoring, Evaluation, Reporting, Verification (MERV)

2

Additionality

- The carbon sequestration project should bring about real, measurable increases in the selected carbon pools.
- The increase in the carbon pool must be over and above what would have occurred without the project (business as usual or BAU)

3

Additionality

- Demonstrating that the project will create real increases over BAU requires calculating what would have happened under BAU.
  - This is called the **Base Case** or **Baseline** estimate.
  - While official methods for calculating baselines have not been adopted, some current methods will be demonstrated in the project development discussion.
  - The COP has asked the IPCC to develop a "good practice guidance" report. This should lead to official guidelines in 2 years or so.
  - Economy in transition – what is BAU? Last 5 years?

4

Leakage

- Leakage refers to changes in carbon sinks or emissions that occur outside the project boundary as a result of the project activities.
  - Displaced activities (e.g. harvesting)
  - Demand shift
  - Supply shift
- For more discussion of leakage issues, see Section 5.3.3 of the IPCC Special Report.

5

Displaced Activities

- Example: Local people are harvesting timber in a forest. As they harvest, they build roads. Farmers then come in and clear the forest. To stop this deforestation, the project buys the forest, creates a park, and prohibits timber harvest. The local people move elsewhere and harvest other forests.

6

Demand Shift

- Example: The United States halts timber harvest on its National Forests to protect remaining wild areas. But the market demand for building materials is unchanged. Part of that demand is met with steel and concrete, which cause much greater CO_2 emissions in their manufacture and use than wood.

7

Supply Shift

- Example: An Asian country halts the harvest and export of hardwoods to Japan. Japan then seeks its supply of hardwood from an African country.

8

Leakage

- Where leakage may exist, it will be necessary to expand the area of accounting to take leakage into account.
  - Where leakage is calculated, those amounts need to be reduced from the project's sequestration amount.
  - It may also be possible to reduce leakage with other activities (such as providing an alternative source of wood or food for local people) that does not create adverse emissions effects.
- Positive leakage is possible, as well.

9

Permanence

- Refers to the length of time that measured carbon pools will retain the increased levels created by the project.
  - This problem is common with many types of emission reduction and sequestration projects, but is a particular concern with agriculture and forestry projects because these projects can easily suffer losses if people change the activities.
  - Commitment Period – How long will the project last, and what mechanisms assure that it will last as long as planned?
  - Risk Management – How will the different types of risk be addressed? (Session 9)

10

Allocation of Carbon Credits

- Negotiated between the project owner and the buyer of carbon credits or project investor.
  - Many different agreements have emerged (RUSAFOR, in Session 14, will be one example).
  - Example: The project plan predicts that the project will sequester an average of 1,000 tons of carbon per year for 50 years. Monitoring and verification show the actual rate as 1,200. Who owns the right to report the additional carbon?
  - No correct answer, but if negotiated during planning and included in plan, can prevent possible conflict later.

11

Allocation of Carbon Credits

- What if project monitoring shows that the project is producing significantly less carbon than predicted? How are the buyer or investor's rights protected?
  - Again, no official answer. Should be part of planning discussions, and agreement on future remedies documented in plan if possible.

12

MERV

- No international methods or policies have been adopted.
- Projects have addressed these needs differently.
- Some guidance can be obtained from the IPCC Special Report, and from prior project experience.
- Costs are an important issue (Transaction costs)

13

Monitoring

- Needs to provide information required by buyer of carbon credits or project investor.
- Needs to be scientifically credible
- Needs to be cost-effective (e.g. frequency)
- Needs to produce verifiable results (standard methods, equipment)
- Needs to be planned for project duration

14

Monitoring

- Layered Approach seems logical
  - 1st Layer
    - Annual report on visible project facts and progress (e.g. the trees are healthy and growing)
    - Reported as part of Annual Forest Inventory if that data is collected in the forest
  - 2nd Layer
    - Periodic measurement of carbon stocks by technically credible method (4 year cycle of FHM?).
      - Measure fixed forest plots; statistical sampling methods
      - Re-sample soil; laboratory analysis of C

15

Monitoring

- New methods may improve accuracy and lower costs of monitoring
  - Aerial imagery
    - Satellite
    - Airplane
  - Improved instruments or techniques for measurements (e.g. GPS, GIS, Field Map 2.0)
- New methods may require changes in the project agreement unless the flexibility to use them has been specifically included.

16

Evaluation

- Some investors or buyers may request that a formal evaluation of projects be done at some future date.
  - May need to evaluate all aspects of project impact, as well as carbon sequestration (e.g. other environmental effects, economic results, social acceptance in community)
    - These are often an important part of an investor or buyer's decision to support a project. Different priorities are often involved.
- No formal requirements yet; but project planners should make sure that any future evaluations requested are budgeted.

17

Reporting

- Requirements are often established by investor or buyer (no international standards yet)
- Need to provide assurance that project plan is being implemented
- Need to keep costs reasonable, and reflected in project budgets.

18

Verification

- Verification is required by project investors or buyers.
- It involves an independent third-party audit of the project. The audit may include:
  - An audit of project records, data management, and reports.
  - An audit of field factors, including technical measurements of reported carbon pools.

19

Verification

- Sustainable Forestry
  - Forest Certification
    - Requires independent third-party audits.
  - International Criteria and Indicators
    - Help countries evaluate sustainability
  - These programs, all fairly new, may become important ways to verify carbon sequestration forestry projects
  - National Forestry Rules for Forest Assessment provide guidelines.

20

Summary of Session 6

- To achieve recognition for national accounting, or for participation in carbon credit trading or market programs, several issues must be addressed in the project plan.
- Formal rules for these issues are lacking, but if project planners make efforts to address them in a transparent manner, the chances are good that they can be successfully addressed.

21

Additional Information

- Hamburg, S.P. 2000. Simple rules for measuring changes in ecosystem carbon in forestry-offset projects. *Mitigation and Adaptation Strategies for Global Change*. 5:1, p. 25-37.
- IPCC Special Report on Land Use, Land-Use Change, and Forestry (Chapter 5), available from www.grida.no/climate/land_use/
- Woerdman, E. and W. van der Gaast. 2001. Project-based emissions trading: The impact of institutional arrangements on cost-effectiveness. *Mitigation and Adaptation Strategies for Global Change*. 6:2, p. 113-154.

22

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 7: Agriculture and Forestry Sequestration Projects

1. Overview

General Objectives: By the end of the session, participants should have a basic understanding of the following:

- How different agricultural and forestry projects may fit into the Kyoto Protocol
- The general types of agriculture and forestry sequestration projects, and how carbon credits are calculated in relation to baselines in each type.
- Some issues and alternatives for institutional frameworks to connect individual projects to markets or national accounting mechanisms

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 45 minutes

Materials: Set of 19 PowerPoint charts.

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

2. Reading and Resources

- Montana Carbon Offset Coalition, Box 404, Somers, Montana 59932, USA
- State Committee on Forestry, Ukraine

Agriculture and Forestry Sequestration Projects

Session 7

Module 9: Carbon Sequestration by Forestry and Agriculture

1

Types of Carbon Projects

- **Conservation** of carbon stocks in existing forests or grasslands from loss due to human activities
- **Changes in management** of agricultural, grassland, or forest to increase carbon stocks
- **Changes in land use** to increase carbon stocks (e.g. cropland to grass or trees).

2

Projects and the Kyoto Protocol

- Depending on the type of project, it may fall under different sections for reporting under the KP
  - If land use change in forests is involved, the definitions of afforestation and deforestation apply, and Annex I Parties are required to account for sources and sinks in the first commitment period. (Article 3.3; COP 7)
  - If no land use change occurs, the broad definitions of forest management, cropland management, and grazing land management apply, and Annex I Parties can decide whether to include in first-period accounting. (Article 3.4, COP 7)
  - If land use change involves revegetation (e.g. planting marginal cropland to grass), Article 3.4 applies (COP 7)

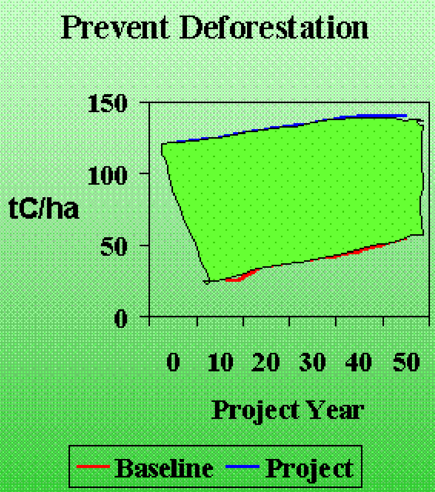
3

Land Use Change and the Kyoto Protocol

From/ To	Crop	Range	Forest	Urban	Wetland
Crop	3.4	3.4	3.3	3.4	3.4
Range	3.4	3.4	3.3	3.4	3.4
Forest	3.3	3.3	3.4	3.3/3.4	3.4
Urban	N/A	N/A	N/A	3.4	N/A
Wetland	3.4	3.4	3.4	3.4	3.4

4

Conservation



- Requires evidence that the baseline would actually occur
- Requires proof that project activity will provide protection.
- Hard to verify.

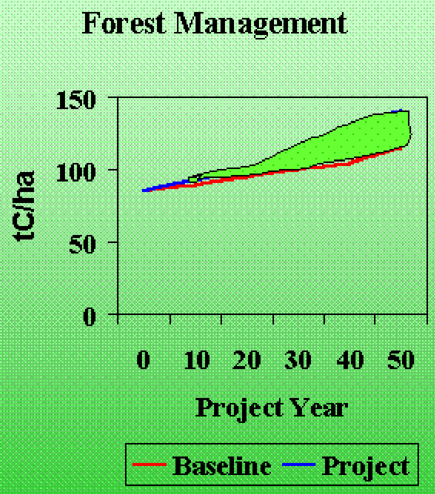
5

Conservation Projects

- Designed to reduce emissions, not increase sequestration
- Popular with environmental groups (e.g. reducing tropical deforestation) and investors (seeking to support “green” projects).
- National accounting is required to calculate emissions from deforestation under Article 3.3 of the Kyoto Protocol
- Conservation projects are not qualified for the CDM (Article 12) in the 2008-2012 accounting period (COP 7)

6

Management Change



- Management change may be hard to prove; Forest will grow naturally.
- May need control plot to show baseline.
- Net benefits likely to be fairly small.
- Easy to verify with control plots; hard otherwise.

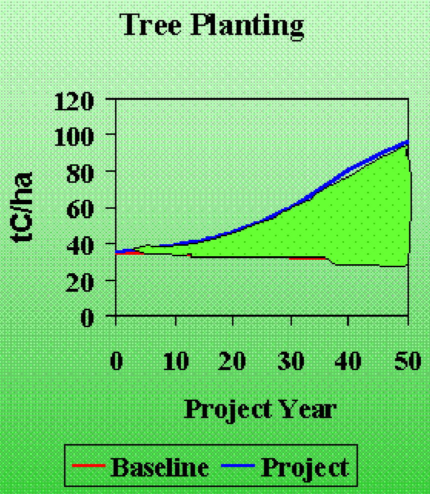
7

Examples of Management Change

- Extend Rotation – Larger Carbon Pool and larger wood products when harvested.
- Fertilize – Faster forest growth
- Use Best Adapted Species
- Needed practices to maintain health and vigor (thinning, pest management, control of invasive species)
- Change harvest methods to reduce soil disturbance, maintain soil shading, and encourage rapid reforestation.

8

Land Conversion



- Converting marginal cropland to trees stops soil deterioration; adds C in trees.
- If soils are low in C, the trees may increase soil C significantly.
- Easy to monitor & verify.

9

Issues in Project Management

- Assembling small projects into large portfolios for market trading
- Assuring long-term monitoring, evaluation, reporting, and verification
- Establishing long-term property rights
  - Carbon Credits
  - Land, trees, harvested wood, etc.
  - Recreation and other land uses.

10

Assembling Portfolios

- Where agricultural or forestry projects are small, it may take many of them to produce enough carbon credits for a large buyer or investor.
- This requires an organization that can establish and operate a program that can administer many projects over a long time.

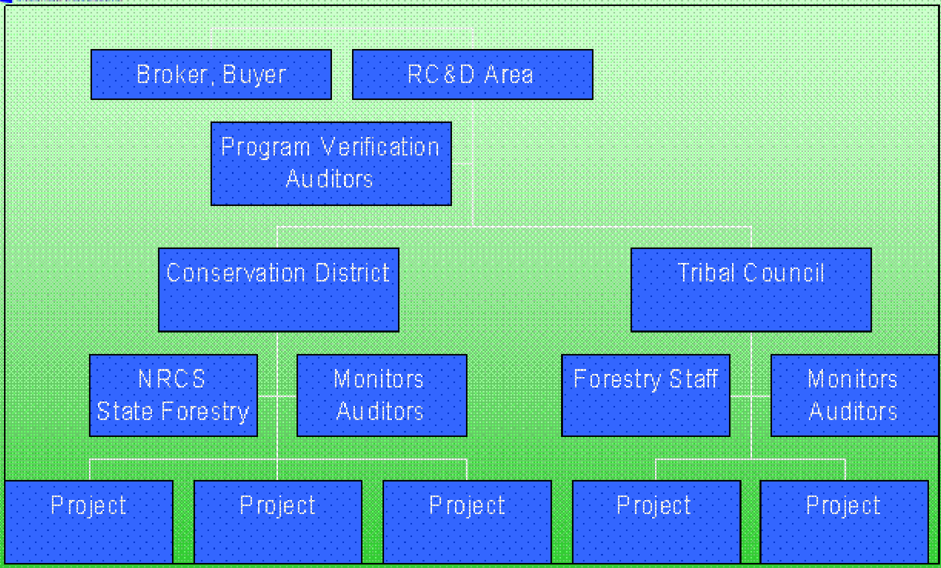
11

Example from U.S.

- Regional organizations called Resource Conservation and Development (RC&D) Areas exist.
  - RC&D's are capable of managing a regional carbon credit program.
    - They work with local agencies, Indian tribal governments, private landowners.
    - RC&D's get technical assistance from state and federal agencies, universities, expert consultants

12

U.S. Program Example



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Advantages of Program

- Large numbers of different projects (and kinds of projects) increase credibility and reduce risks.
  - Where there are many projects, one disaster will not affect all of them.
  - If the carbon estimates are calculated conservatively, a few projects may fail, but other projects may produce extra carbon, so the total portfolio can continue to meet goals.

14

Advantages of Program

- RC&D establishes policies for planning and installing projects
  - Helps assure reasonable consistency between different local projects
  - More efficient for expert advisors and public agencies because their work affects large numbers of people and projects
  - Local organizations are known and trusted by landowners and local people.

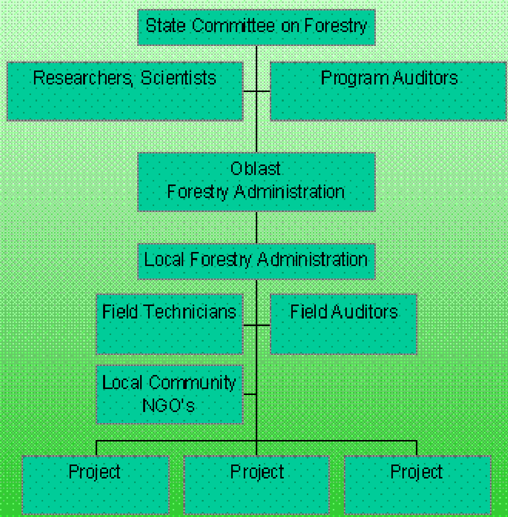
15

Ukraine Example

- Existing forestry agency and structure is in place to administer a program that featured local forestry projects.
- Preparing local project plans with carbon credit calculations will be necessary for program to attract carbon credit donors or buyers.

16

Ukraine Example



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Summary – Session 7

- 3 Types of Projects with different characteristics and relation to the Kyoto Protocol
  - Conservation
  - Management change
  - Land use or cover change
- Assembling small projects for market sales or national accounting will require an organization and structure to administer a carbon credit program.

18


ІНІЦІАТИВА
CLIMATE
For further information
• State Committee on Forestry, Ukraine
• National Carbon Offset Coalition, Box 404, Somers, Montana 59932, USA
• For market-oriented web sites, see Session 9.
19

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 8: Environmental, Social, and Economic Issues in Project Development

1. Overview

General Objectives: By the end of the session, participants should have a basic understanding of the following:

- The major environmental issues likely to be associated with different types of forestry and agricultural projects.
- Some of the social and economic issues likely to arise.
- Some alternatives for considering and addressing these issues in the process of project planning and implementation.

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 45 minutes

Materials: Set of 22 PowerPoint charts.

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

2. Reading and Resources

Sedjo, Roger A., R. Neil Sampson and Joe Wisniewski (eds). 1997. Special Issue: Economics of Carbon Sequestration in Forestry. *Critical Reviews in Environmental Science and Technology*, Volume 27/special issue.

Sedjo, R.A., J. Wisniewski, A. Sample and J.D. Kinsman. 1994. *Managing Carbon via Forestry: Assessment of Some Economic Studies*. Washington, DC: Resources for the Future. 39 pp.

Environmental, Social, and Economic Issues in Project Development

Session 8

Module 9: Carbon Sequestration by Forestry and Agriculture

1

Environmental Issues

- Conversion of Primary Forests
- Soil Erosion and Water Pollution
- Biological Diversity
- Replacing native grassland with trees

2

Conversion of Primary Forests

- Plantations:
  - Less valuable for biodiversity and habitat than primary forest
  - May reduce traditional uses of primary forest
  - Increased wood production may reduce harvest pressure on primary forests
  - If planted on cropland, will improve habitat and biodiversity (if done right)

3

Soil Erosion and Water Pollution

- Converting marginal cropland to forest will generally halt soil erosion and slowly rebuild soil quality.
- If there are gullies present, they can be healed with trees.
- This will also help prevent water pollution and flooding.

4

Biological Diversity

- Planted forests can support more biological diversity than cultivated lands.
- Projects can enhance their value for landscape biological diversity by:
  - Planting forests that duplicate natural forests or restoring degraded forests
  - Planting multiple species, including adapted understory species.
  - Establishing native hardwood species along stream banks and valley areas.

5

Replacing Native Grasslands

- Planting large areas of trees on native grasslands, such as the Ukrainian steppe grasslands, results in conversion of ecosystems and loss of grassland values.
- It may be positive from the environmental viewpoint to plant trees in valleys where they naturally occurred, or in windbreaks or shelterbelts where steppe soils are being used for cropland.

6

Social Issues

- Traditional land users
  - Grazing
  - Hunting, recreation
  - Religious, cultural
- Community "Ownership" of Project
  - Participation in planning, implementation, benefits
  - Participation in protection
- Fear of future policy change; skepticism about long-term government commitment
  - Land tenure rights, illegal activities, war, corruption

7

Traditional Land Users

- If local people have traditionally used these lands for some purpose, they may oppose the project if they think it will take those rights away from them.

8

Community Ownership

- Discussing the project with the people in the community during planning may increase their support.
- If there are benefits for the community such as access to firewood or local jobs, that can be positive.
- If the people in the community (NGO's, schools, etc.) are part of the effort to protect the forest, they will see it as "theirs."

9

Community Ownership

- If people feel that a future government policy may change the situation with the project, they may be reluctant to make long-term commitment to the project.

10

Economic Issues

- Calculating all project costs
  - Installation of project, administration as well as field work.
  - Regular maintenance and protection
  - Monitoring – Verification
  - Reporting and record-keeping

11

Project Costs

- Maintenance and Protection
  - Weed and grass control until canopy closes.
  - Fire protection
  - Thinnings (may produce some sales as well)
  - Insect and disease protection
  - Other maintenance (roads, boundaries, etc.)

12

Project Costs

- Record-keeping, reporting, and overall program administration.
  - Who will do it?
  - What will it cost?

13

Project Costs

- Monitoring
  - Set up schedule and estimate costs
    - Annual monitoring (who will do, what will they do?)
    - Periodic measurements (every 4 years? Who will do? What will they do?
- Verification
  - Who will do independent 3rd party audits? How often? What will they cost?

14

Project Costs

- Planning and Installation
  - Technical & professional work, administration
  - Land preparation
  - Cost of trees and planting crews
  - Control of weeds and grass
  - Replanting trees that don't survive

15

Economic Topics

- Calculating Project Benefits
  - Carbon Sequestration
  - Other environmental benefits (monetary and non-monetary)
  - Wood or non-wood products during project years or after.

16

Project Benefits

- Carbon Sequestration
  - Calculating carbon sequestration will be covered in another session. Formal rules on whether, or how, to do these calculations have not yet been decided.
- Other Environmental Benefits
  - Soil protection, water quality, wildlife habitat, landscape diversity
  - Some can be quantified by comparison to the base case. Some can only be described.

17

Project Benefits

- Wood or other products
  - Forest thinning during the project
    - How often? What will be produced? Who will get these products?
  - Will there be other products that people can use from the forest? Who will get them?
    - Mushrooms, greens, medicines?

18

Project Benefits

- At what age will the forest mature and be ready for timber harvest?
- What size wood will be produced; where will it go; what type of finished products will be created? What will they contribute to C sequestration?

19

Project Economics

- Formal rules on how to calculate project costs and benefits have not been agreed upon.
- The fund investor or buyer of carbon credits may have requirements, and these may differ between investors.
- Project planners will need to determine exactly what each investor requires.

20

Summary of Session 8

- All projects will face important environmental, social, and economic issues.
- These issues may be significantly different between different types of projects, or in different situations.
- Project planners who concentrate on technical issues and do not address some of these important questions may encounter public opposition that can kill a good project idea.

21

Further Information

- Sedjo, Roger A., R. Neil Sampson and Joe Wisniewski (eds). 1997. Special Issue: Economics of Carbon Sequestration in Forestry. *Critical Reviews in Environmental Science and Technology*, Volume 27/special issue.
- Sedjo, R.A., J. Wisniewski, A. Sample and J.D. Kinsman. 1994. *Managing Carbon via Forestry: Assessment of Some Economic Studies*. Washington, DC: Resources for the Future. 39 pp.

22

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 9: Risk Management Issues in Project Development

1. Overview

General Objectives: By the end of the session, participants should have a basic understanding of the following:

- The general types of risk associated with forestry and agricultural projects.
- Some alternatives for managing these risks in project planning and implementation.
- The importance of managing risk to improve people's confidence in the permanence of the carbon sequestered by agriculture and forestry activities.

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 30 minutes

Materials: Set of 18 PowerPoint charts.

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

2. Reading and Resources

Bartell, S.M., R.H. Garner, and R.V. O'Neill. 1992. *Ecological Risk Estimation*. Boca Raton, FL: Lewis Publishers.

Brown, J. 1989. *Environmental Threats: Social Science Approaches to Public Risk Perception*. London: Belhaven.

The Royal Society Study Group. 1992. *Risk Analysis, Perception and Management*. London: The Royal Society.

Stern, Paul C. and Harvey V. Fineberg (eds). 1996. *Understanding Risk: Informing Decisions in a Democratic Society*. Washington: National Academy Press.

Risk Management Issues in Project Development

Session 9

Module 9: Carbon Sequestration by Forestry and Agriculture

1

Risk Management

- The concern that carbon sequestered in a project may be lost at some future time raises the question about how permanent the project benefits may be.
- While nothing in nature is permanent, it is possible for project planners to identify the major risks involved, and include plans to minimize those risks.

2

Risk Management

- Most potential investors or carbon credit buyers are sophisticated investors. They make decisions based on their assessment of the risks and price involved. The general rule is:
  - The higher the risk, the lower the price a buyer will be willing to pay. Low risk investments attract a higher price.
- Planners are wise to identify all risks and show how the project will attempt to reduce them.

3

Investment Decisions

- In addition to calculating risk and price trade – offs, investors in projects will consider:
  - Corporate strategy or policy
  - The investment environment in the country where the project is located (is it stable?)
  - The public relations value involved

4

Types of Project Risk

- Installation
- Maintenance
- Performance
- Abandonment
- Disaster
- Political, Economic, Technological Change

5

Installation Risk

- **Practices wrong for site, not installed, fail**
  - Bad planning, bad effort, bad luck
- **Solutions**:
  - Professional planning assistance
  - Professional assurance of installation
  - Credible plans (and funds) to restore practices if they fail due to weather or disaster (fire).

6

Reducing Failures

- Use local experts to design project details.
- Use locally-adapted species and best known planting and protection practices
- Hold a small amount (~10%) of the budget in reserve to provide funds for weather or disaster failures.

7

Maintenance Risk

- **Failure to consistently apply practice** (e.g. Conservation tillage, Fire protection)
- **Solution**
  – Periodic Monitoring and reporting
- **Practice is not Performing as Predicted**
- **Solution**
  – Adjust Contract (if allowed)
  – Revise Technical Handbook

8

Maintenance

- Have a maintenance plan as part of the project, and budget necessary funds to carry out maintenance and protection activities in future years.
- Require local manager to report on maintenance and protection work.

9

Performance

- Project performance is estimated during project planning on the basis of best available growth and yield models.
  - Using conservative estimates to leave a margin for error is advisable.
- If monitoring proves that the change in carbon stock is significantly different than predicted, change the technical manual or yield models to reduce errors in future projects.

10

Abandonment Risk

- **Long-term Contracts: Short-term Tenure**
  - Private landowner sells land or dies; carbon contract not followed.
  - Economic or social conditions change, so owner decides to void contract.
    - **Note: Legally-binding contracts must be enforced to be of value**
- **Solution 1: Conservation Easements**
  - Primarily useful on private lands with strong landowner contract tradition
- **Solution 2: Public Ownership of Land**
  - Requires strong laws or policy to enforce plan.

11

Abandonment

- This should not be a problem in Ukraine where the projects will most likely be on state-owned lands.
- Having a specific policy about the maintenance of long-term carbon credit contracts may be useful.

12

Disaster Risk

- **Fire, Flood, Disease, Insects, etc.**
  – Good management can reduce risks, but not prevent all disasters
  – Good Plan and maintenance program helps.
- **Solution: Insurance**
  – Public agency may insure by committing to replace lost carbon on these or other lands.
  – Private owner may be able to purchase insurance

13

Disasters

- Good management to keep forests healthy is important, but a major disaster like a big fire or wind can cause much damage.
- A State policy on restoring damaged projects may provide added confidence in investors or carbon credit buyers.

14

Political, Economic, or Technological Risk

- **Changing Policies**
- **Bad Economic Forecasts**
  - Energy example
- **New Technology**
  - Regulated industry will use least-cost solution to reduce emissions
  - Price of purchased credits will reflect best available technology.

15

Political/Technological

- These are impossible to forecast, so most buyers or investors simply consider their assessment of the situation and agree to participate accordingly.

16

Summary of Session 9

- Addressing known risks, and doing practical things to minimize them, builds confidence in a project.
- This confidence may be critical in winning financial support for project action.
- Some risks cannot be predicted or prevented, but if they are discussed and their impact estimated, project reviewers will gain confidence in the quality of the project plan.

17

Further Information

- Bartell, S.M., R.H. Garner, and R.V. O'Neill. 1992. *Ecological Risk Estimation*. Boca Raton, FL: Lewis Publishers.
- Brown, J. 1989. *Environmental Threats: Social Science Approaches to Public Risk Perception*. London: Belhaven.
- The Royal Society Study Group. 1992. *Risk Analysis, Perception and Management*. London: The Royal Society.
- Stern, Paul C. and Harvey V. Fineberg (eds). 1996. *Understanding Risk: Informing Decisions in a Democratic Society*. Washington: National Academy Press.

18

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 10: Calculating Emission Reduction Credits in Project Planning

1. Overview

General Objectives: By the end of the session, participants should have a basic understanding of the following:

- General science-based approaches to calculating the amount of carbon sequestration in agricultural soils and forests as a result of project action
- How to convert forest growth and yield data into carbon sequestration estimates
- How to address issues such as baselines, additionality, and leakage.

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 45 minutes

Materials: Set of 37 PowerPoint charts.

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

2. Reading and Resources

Birdsey, Richard A. 1996. Carbon Storage for Major Forest Types and Regions in the Conterminous United States, Tables 1.1 to 1.3, in Sampson, R. Neil and Dwight Hair. 1996. *Forests and Global Change, Volume* 2. Washington, DC: American Forests

IPCC. 1997. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*

State Committee on Forestry in Ukraine. National Yield Tables

Calculating Emission Reduction Credits in Project Planning

Session 10

Module 9: Carbon Sequestration by Forestry and Agriculture

1

Calculating Carbon Credits

- Formal rules on how to calculate carbon credits have not been adopted. Some general rules seem reasonable:
  - All calculations should be science-based.
  - Calculations should be transparent. A reviewer should be able to reproduce the numbers by following the explanation given by the planner.
  - Calculations should be conservative to help assure that the project meets or exceeds the projected amounts.

2

Calculating Carbon Credits

- Carbon Credits are calculated on the following equation:

$$CC = C_{PROJ} - C_{BASE} - C_{LEAK}$$

Where:

- CC = Carbon credits claimed
- C_{PROJ} = Carbon credits produced by the project
- C_{BASE} = Carbon credits produced by the base case
- C_{LEAK} = Estimated amount of leakage calculated

3

Project Credits

- Potential carbon credits are calculated on the basis of the amount of carbon that is sequestered into above-ground and below-ground woody biomass, soil, understory, litter, and dead wood pools over the agreed project life.
- The calculation is based on the predicted change in the size of the pools selected for measurement, over the project life.

4

Selecting Carbon Pools

- Carbon pools that will change significantly should be selected for estimating carbon credits.

  Soil – the soil carbon may change significantly under such practices as planting grass or trees on marginal land.

  - The main point is the current condition of the soil. If it has been depleted in carbon, it may be possible to bring it back to near-normal conditions. If it is already at or near normal for this site, the amount added may be negligible.

5

Selecting Carbon Pools

- General guidelines –
  - If a carbon pool will increase significantly, estimate the carbon credits and make plans to monitor and measure the pool.
  - If a carbon pool will decrease under the new management, estimate the decline and subtract it from the credits claimed.
  - If a carbon pool will stay the same, or increase only slightly, state the scientific reasons for this assessment and do not claim credits or measure this pool.
    - The IPCC Reporting Guidelines are useful here, and they provide default values that might be used.

6

Example: Agricultural Case

- This example is for a project that proposes to convert marginal agricultural land to native grassland, and use the grassland to graze livestock.

7

Step 1. Describe the Base Case

- The base case is what will happen if the project is not done.
  - Historic and current land use trends may be helpful.
- It requires a forecast of the future situation, which may be best stated in terms of probability and likelihood. Example:
  - "This land will probably remain in cultivation, even though the yields are low. Without the project's support for changing land use, it is unlikely that the people will be able to make any change. This situation could continue for 50 years unless economic or other conditions change significantly."

8

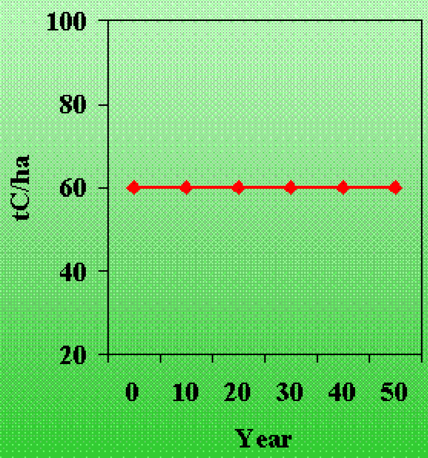
Step 2. Estimate the Carbon Baseline

- If the base case as described were to occur over 50 years, what would happen to the carbon pools involved?
  - In this example, the only carbon pool involved is the soil. What is the scientific evidence about the soil condition in the base case? Will it stay the same, or decrease, or increase? Make an assessment and support it with scientific arguments.

9

The Carbon Baseline

- Example: The carbon pool in the soil will remain the same over the next 50 years under the base case.
- The carbon baseline would look like



10

Step 3. Describe the Project Case

- Example:
  - "Under the project, the land will be planted to native grasses. The grass will be protected until it is well established, then grazed under a grazing plan that will keep the native grasses strong and sustainable."

11

Rate and Duration of Carbon Sequestration in Agricultural Soil

	Rate of C sequestration		Duration
Practice	High/Low	Average	(Years)
	tC/ha/yr		
Reduced tillage	0.2 - 0.6	0.4	25
Fertility management	0.2 - 0.6	0.4	25
Cropland to grass	0.5 - 1.0	0.8	50

Source: IPCC Special Report, Table 4-4

12

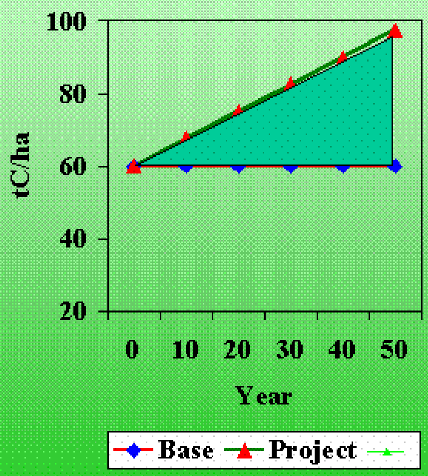
Step 4. Calculate the Project Carbon

- Research indicates that converting cultivated land to grass will result in increased soil carbon at the rate of 0.5 to 1.0 tonnes per ha per year. Select a rate that seems most appropriate to the soil and site involved. Example: 0.75 tC/ha/yr for 50 years.
- Total C increase in 50 years = 37.5 tC/ha.

13

The Project Carbon

- If the project produces new soil carbon at the predicted rate of 0.75 tC/ha/yr., the soil carbon pool will increase:



14

Step 5. Consider Leakage

- Will this project cause actions somewhere else that might create new carbon emissions or sinks? This is, again, largely a matter of prediction, so should be stated in terms of probability and uncertainty. Example:
  - "It appears that the cultivation of these lands has not been essential to the community, and the community is not undergoing rapid population growth, so it is unlikely that any new lands will be cultivated unless there is a major unforseen change in conditions."

15

Step 6. Calculate Leakage

- If the description of leakage is that it will probably not exist, and this argument can be supported by evidence, the calculated amount of leakage would be zero.

16

Step 7. Calculate the Project Carbon Sequestration

- Solve the formula:

  $CC = C_{PROJ} - C_{BASE} - C_{LEAK}$
- $CC = 37.5 - 0 - 0 = 37.5$ tC/ha
- If the project will be done on 500 ha, the total carbon credits claimed would be:

  $37.5 \times 500 = 18{,}750$ tC
- If there is scientific uncertainty about the rate of C sequestration, it may be advisable to discount the estimate. For example, if the probability is 90%:

  $CC = 18{,}750 \times 0.9 = 16{,}875$ tC

17

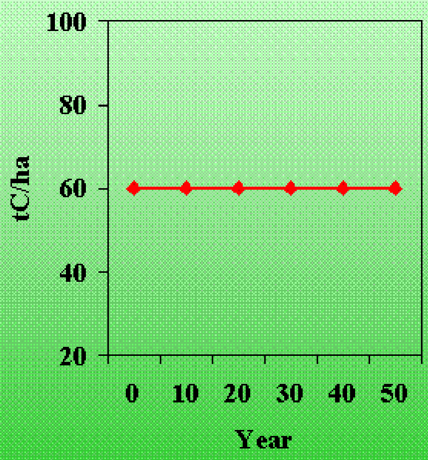
Afforestation Example

- This example shows what might happen if the same marginal cropland were planted to trees. This assumes that the natural vegetation on the land was forest, and that a forest adapted to the site can be re-established.

18

Steps 1-2. The Base Case

- For this example, we assume the same base case as before. The land will continue in cultivation. The soil carbon will remain the same or decline slightly.



19

Step 3. The Project Case

- Example:
  - "Under this project, pine will be planted with the recommended local methods to assure a full forest stand that can be managed as a model forest. The carbon accounting will be done for 50 years, but the forest will be maintained longer – probably 100 years or so – before it is harvested and re-planted."

20

Step 4. Calculate the Project Carbon

- This is more complicated that calculating soil carbon because to calculate the carbon in the forest, we must first estimate the yield of merchantable wood that will be produced at age 50, then convert that number into an estimate of how much carbon is contained in the entire forest (roots, stumps, and large branches as well as tree stems).

21

Estimating Forest Growth

- To estimate the forest growth, it is necessary to identify the soil and site condition for the selected species (pine). For example, on this 500 ha project:
  - 100 ha = Site I
  - 300 ha = Site II
  - 100 ha = Site III
  - No land in Site IV

22

Yield Table – Pine

	Wood Yield (M^3 / ha)			
Age	Site I	Site II	Site III	Site IV
20	112	91	72	52
30	224	176	136	100
40	339	267	208	154
50	447	353	274	206
60	538	426	332	251
70	616	487	383	290
80	680	540	426	325
90	736	585	463	354
100	785	625	494	380

Source: National Yield Tables, State Committee on Forestry

23

Estimating Forest Growth

- Using the Ukrainian Yield Table, calculate the wood yield at age 50:

  100 ha x 447 = 44,700 m^3

  300 ha x 353 = 105,900 m^3

  100 ha x 274 = 27,400 m^3

  500 ha total = 178,000 m^3

  Average yield for project = 178,000/500 = 356 m^3 /ha.

  Average annual yield for project = 356/50 = 7 m^3/ha/yr.

24

Estimating Carbon in Wood Pool

Species	Specific Gravity	Percent Carbon	Multiply to Whole Tree
Pine	0,47	0,531	1.682
Oak	0,61	0,498	2,418
Beech	0,58	0,498	2,418
Birch	0,46	0,498	2,418
Fir	0,35	0,512	2,254
Spruce	0,43	0,512	1,675

Source: Birdsey, Richard A. 1997. Carbon Storage for Major Forest Types and Regions in the Conterminous United States, Tables 1.1 to 1.3, in Sampson, R.Neil and Dwight Hair. 1996. Forests and Global Change, Volume 2. Washington, DC: American Forests

25

Carbon in Wood Pool

- The total merchantable wood = 356 m^3/ha
- Calculate the total tree biomass with the correct factor:
  - Total tree = 356 x 1.682 = 599 m^3/ha
- Convert biomass volume to weight using the specific gravity
  - 599 x 0.47 = 281 tonnes/ha
- Convert the biomass weight to carbon weight
  - C_{WOOD} = 281 x 0.531 = 149 tC/ha

26

Estimating Soil Carbon

- Example: Scientists predict that the pine trees will increase the soil carbon pool about ½ as much as was calculated for native grass, or about 18 tC/ha in 50 years. $C_{SOIL} = 18$

27

Steps 5 & 6. Leakage

- Will planting this land to trees cause some other land to have the forest cut down for agriculture?
  - If yes, some leakage should be calculated
  - If no, there is little chance of any leakage
- In this example, we will propose that a small amount of leakage may occur outside the project area. The best estimate is that it will equal about 10% of the project's wood carbon. Thus:
  - $C_{LEAK} = 0{,}10 * C_{WOOD}$

28

Step 7. Total Carbon Increase

Total carbon = wood + soil – base - leakage

$C_{PROJ} = C_{WOOD} + C_{SOIL} - C_{BASE} - C_{LEAK}$

$C_{PROJ} = 149 + 18 – 0 – 15 = 153$ tC/ha

For the total project:

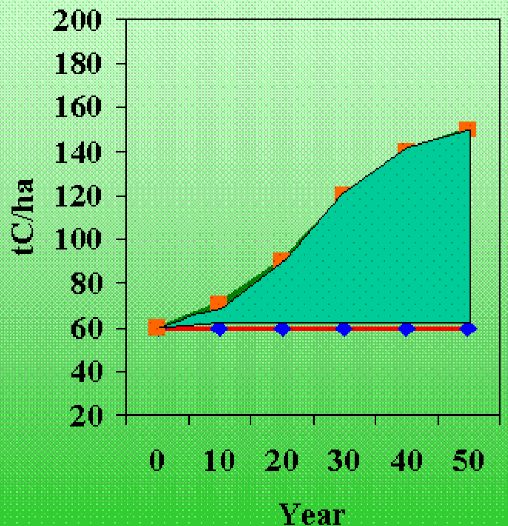
CC= 153 tC x 500 ha = 76,500 Tc at age 50

At 95% confidence, we would claim 72,675 tC

29

The Forest Project

The project will sequester about 150 tonnes of carbon per ha over the 50-year project life. This is based on the best scientific evidence, discounted 10% for uncertainty.



30

Other Forest Projects

- If a project were to be planted to oak, for example, the Oak table would be used for estimating yields, and the correct conversion factors would be chosen for converting from wood to total carbon. Each project should use the best available soil, site, yield, and conversion information available.

31

Yield Table – Oak

	Wood Yield (M^3 / ha)		
Age	Site I	Site II	Site III
20	65	49	31
30	115	84	56
40	164	119	82
50	211	154	108
60	256	189	135
70	298	223	162
80	338	256	188
90	375	287	213
100	409	316	237

Source: National Yield Tables, State Committee on Forestry

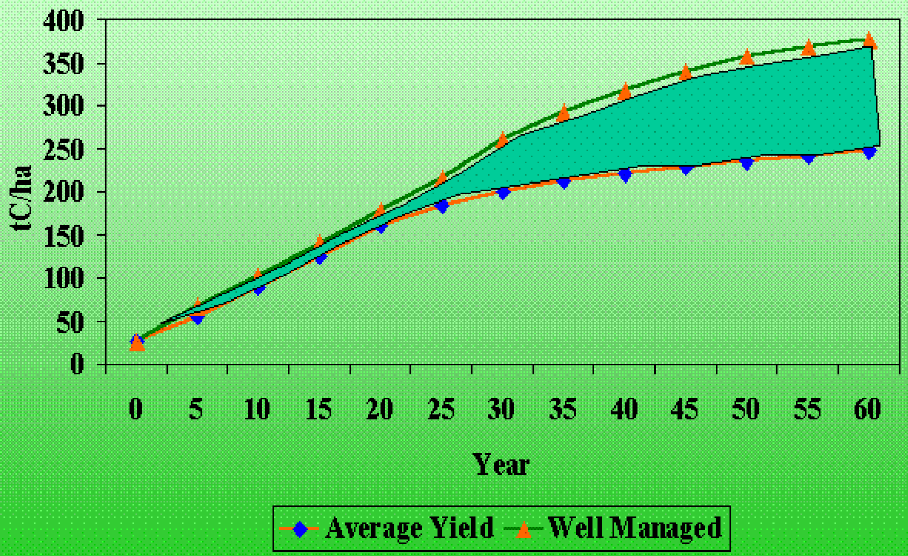
32

Forest Management Project

- While the rules have not been established, there may be a way to set baselines for forest growth on the basis of regional data.
- This would mean that, if a forest manager could demonstrate that their forest was sequestering more carbon than the regional average, they might get carbon credit for that additional amount.

33

Loblolly Pine, Southeastern U.S.



34

Management Case

- Note that, in this example, the baseline is rising over time. If it is accepted as an official baseline for the region, then a manager that can create a measured increase due to improved management could claim a carbon credit.
- Similar data can be shown for Ukraine.

35

Summary of Session 10

- For any type of project, the carbon credits are the difference between the project case and the base case.
- Both cases are predictions of future activity and ecosystem performance, so must be based on good science.
  - No prediction is certain, so conservative estimates should be used.
- Show all assumptions and calculations so that a reviewer or auditor can follow them.

36

Further Information

Birdsey, Richard A. 1996. Carbon Storage for Major Forest Types and Regions in the Conterminous United States, Tables 1.1 to 1.3, in Sampson, R.Neil and Dwight Hair. 1996. *Forests and Global Change, Volume 2*. Washington, DC: American Forests

IPCC. 1997. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*

State Committee on Forestry in Ukraine. National Yield Tables

37

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 11: Developing Sequestration Project Plans

1. Overview

General Objectives: By the end of the session, participants should have a basic understanding of the following:

- The general steps in project planning.
- The skills and information that may be needed to develop a project plan for carbon sequestration.
- Ideas about how to apply this approach to a familiar situation in Ukraine.

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 30 minutes

Materials: Set of 13 PowerPoint charts.

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

2. Reading and Resources

A sample plan outline is provided as an appendix. It should be handed out to participants at the end of the session and discussed briefly. It can be the basis for the project plan they develop as part of the working group sessions later in the workshop.

Developing Sequestration Project Plans

Session 11

Module 9: Carbon Sequestration by Forestry and Agriculture

1

The General Planning Process

1. Identify problems and opportunities
2. Determine objectives
3. Inventory resources
4. Analyze resource data
5. Develop alternative actions
6. Evaluate alternatives
7. Decide which actions to take
8. Implement the plan
9. Evaluate the results, modify if needed.

2

Identify problems and opportunities

1. Identify potential project area
2. Identify resource problems
   Soil quality poor due to cultivation or erosion
   Low productivity under current use
   Current use not sustainable or appropriate
   Other?
3. Opportunities to address problems
   Improve management methods
   Restore degraded forest or grassland
   Change land use; plant land to grass
   Change land use; plant land to trees
   Other?

3

Determine Objectives

- Increase carbon sequestration
- Improve soil quality
- Stop soil erosion
- Convert to a sustainable land use
- Protect water quality
- Produce products; grazing, wood, other

4

Inventory Resources

- Land ownership and tenure
- Soil types and productivity
- Climate
- Water resources
  - Quantity
  - Quality
- Regional issues (wildlife habitat, landscape diversity)

5

Develop Alternative Plans

- What activities are available to address the problems identified and achieve objectives?
- There may be more than one way to solve the problem.
  - Some soils, for example, will grow either grass or trees equally well. Which should be chosen? This question can be answered when all the costs and benefits of each have been identified.

6

Evaluate Alternatives

- Choosing the best alternative may involve many people.
  - Local community
  - Local NGO's
  - State leaders (policy needs to be followed)
  - Scientists – may have strong opinions as to best scientific approach

7

Make Decisions

- Final decision rests with authority over land
- When activities have been chosen, planner needs to make final implementation plan, for example:
  - Exactly how will the activity be done
  - Who will do it?
  - Is the budget adequate?
- Final approval may be needed

8

Implement the Plan

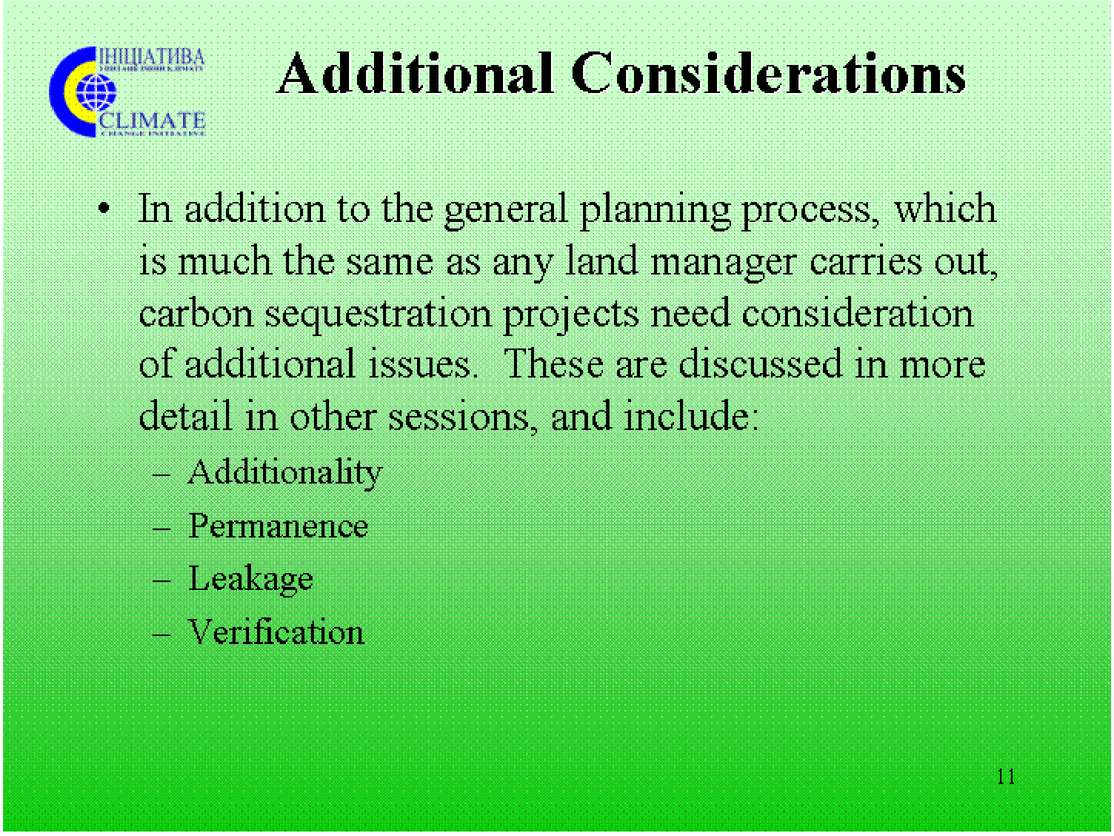
- Good management is needed to assure that the activity is installed as planned.
- Document how the activity was carried out, and any problems encountered.
- Prepare reports

9

Evaluate

- Follow up over the lifetime of the project. For example:
  - Did the grass or trees grow as expected?
  - Were problems encountered?
    - Were they solved? How?
  - Are there lessons to be learned for future activities?

10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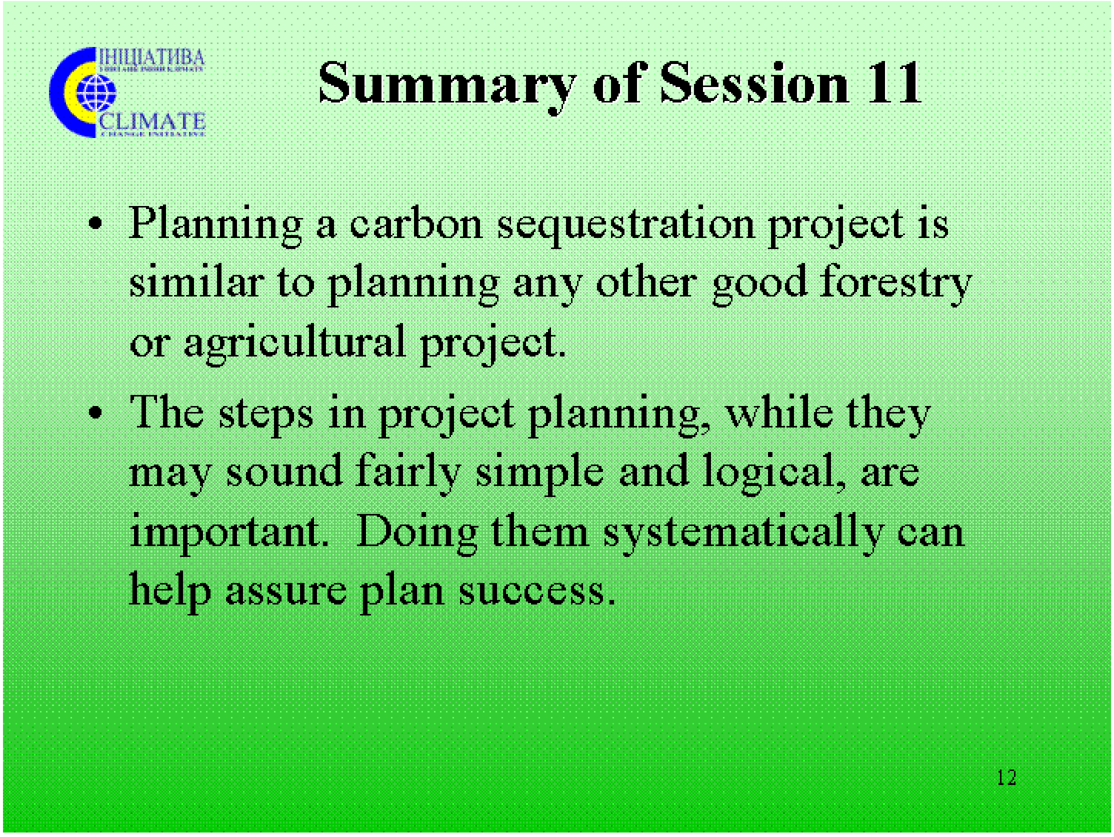
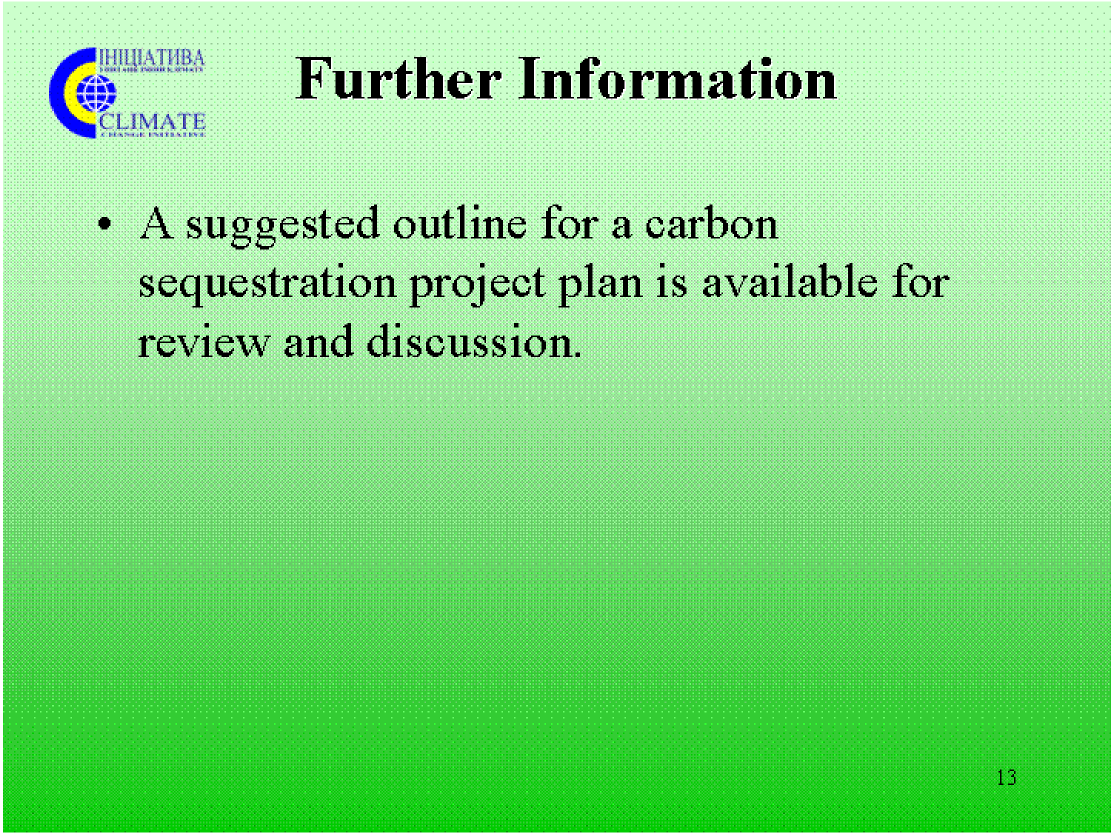
CLIMATE
Additional Considerations
• In addition to the general planning process, which is much the same as any land manager carries out, carbon sequestration projects need consideration of additional issues. These are discussed in more detail in other sessions, and include:
– Additionality
– Permanence
– Leakage
– Verification
11


ІНІЦІАТИВА
CLIMATE
Summary of Session 11
• Planning a carbon sequestration project is similar to planning any other good forestry or agricultural project.
• The steps in project planning, while they may sound fairly simple and logical, are important. Doing them systematically can help assure plan success.
12


ІНІЦІАТИВА
CLIMATE
Further Information
• A suggested outline for a carbon sequestration project plan is available for review and discussion.
13

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 12: Case Study from the United States – The Tramway Project

1. Overview

General Objectives: By the end of the session, participants should have a basic understanding of the following:

- The manner in which a tree planting project in the United States was planned and explained to potential market buyers.

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 30 minutes

Materials: Set of 24 PowerPoint charts.

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

2. Reading and Resources

Birdsey, Richard A. (1996). Carbon Storage in United States Forests, in R. Neil Sampson and Dwight Hair (eds), *Forests and Global Change, Volume II: Opportunities for Improving Forest Management*, Washington, DC: American Forests.

Case Study from the United States – The Tramway Project

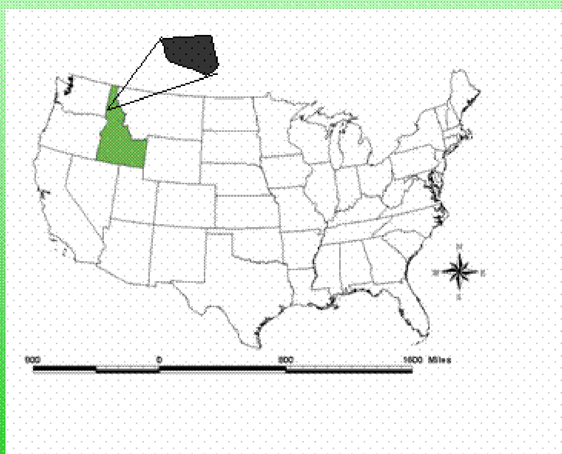
Session 12

Module 9: Carbon Sequestration by Forestry and Agriculture

1

The Tramway Project

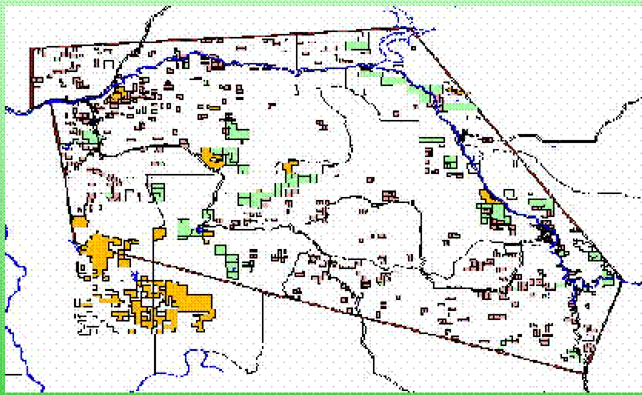
The Tramway project is on the Nez Perce Indian Reservation in the northern part of the State of Idaho in the United States.



2

The Tramway Project

The Tribe's land is in small pieces scattered throughout the reservation.



3

The Tramway Project

- Since the early 1900's, some Tribal land was farmed by local farmers, who grew crops of wheat, barley, and hay.
- The lands are sloping, and soil erosion was a problem under crop cultivation.
- In recent years, the Tribe has strengthened its forestry program, and wishes to plant these lands back to the native forest of ponderosa pine (*pinus ponderosa)*.

4

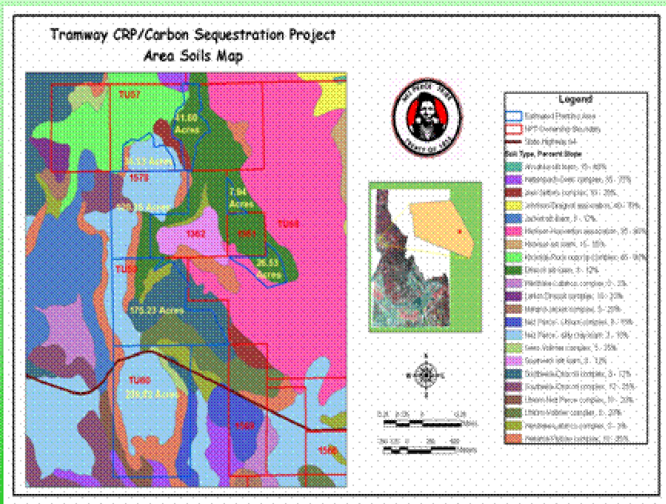
The Tramway Project

- Tribal funds for tree planting are limited, so the Tribe will sell carbon credits to help pay the planting costs.
- To market the credits, they prepared a project plan, which was presented to the Montana Carbon Offset Coalition, a group of organizations that assembles carbon sink projects and sells them on the open market.

5

The Project Plan

- The project area is 271 hectares. Soil maps provide soil data.



6

The Project Plan

- Soils were placed in 3 groups based on potential timber growth.

Soil Group	Area (ha)	Timber Yield (M^3/ha/yr)
High Production	182	8.9
Medium	42	6.5
Low	47	4.1

7

The Project Plan

- The project is planned for 80 years. The wood yield at that time will total 167,479 M^3

Soil Group	Area *(ha)*	Timber Yield *(M^3/ha/yr)*	Total at Age 80 *(M^3)*
High	182	8.9	130,312
Medium	42	6.5	21,870
Low	47	4.1	15,296
Total	271		167,479

8

Calculate Carbon in Trees

1. Convert wood yield to total biomass in the trees (add roots, stump, branches)

   167,479 x 2.254 = 377,497 M³ total biomass

2. Convert biomass to weight

   377,497 x 0.38 (Specific Gravity) = 143,449 tonnes

2. Convert biomass to carbon

   143,449 x 0.512 (%C) = 73,446 tonnes

9

Calculate Soil Carbon

- Obtain data from soil horizons to 30 cm. (bulk density and percent organic matter)
- Calculate soil carbon weight in top 30 cm of soil (surface 30 cm. will change most under management)
- Estimate how much soil carbon will change under continued cultivation (base case).
- Estimate how much soil carbon will change under forest cover (project case).

10

Soil Carbon – Existing

Soil Group	Horizon	Bulk Density	Organic Matter (%)	Carbon *(tC/ha)*
High	A-28 cm B- 2.5 cm Total	1.18 1.18	7.0 5.0	133.9 8.7 142.5
Medium	A- 23 cm B- 7.5 cm Total	1.30 1.38	6.0 2.0	103.4 12.2 115.6
Low	A- 28 cm B- 2.5 cm Total	1.18 1.20	5.0 3.0	95.6 5.3 100.9

11

Soil Carbon Change

- Assume that soil carbon will not change under continued cultivation. *(Scientific basis: after 60 years of cultivation, soil C has probably stabilized and will remain fairly stable.)*
- Assume that soil carbon will increase by 1% in top horizon over 80 years. *(Scientific basis: Original topsoil was 2-3% higher than present. Likely to add at least half of that amount (or more) back under forest cover.*

12

Soil Carbon – Project

Soil Group	Horizon	Bulk Density	Organic Matter (%)	Carbon *(tC/ha)*
High	A-28 cm B- 2.5 cm Total	1.18 1.18	8.0 5.0	153.0 8.7 161.7
Medium	A- 23 cm B- 7.5 cm Total	1.30 1.38	7.0 2.0	120.7 12.2 132.9
Low	A- 28 cm B- 2.5 cm Total	1.18 1.20	6.0 3.0	114.7 5.3 120.0

13

Soil Carbon – Change

Soil Group	Project *(tC/ha)*	Base Case *(tC/ha)*	Added Carbon *(tC/ha)*	Area *(ha)*	Total Added C *(tC)*
High	162	143	19	182	3,480
Medium	133	116	17	42	724
Low	49	41	8	47	364
Total				271	4,568

14

Addressing Project Issues

- Additionality
- Permanence/Risk
- Leakage
- Monitoring, Reporting, and Verification
- Additional Benefits

15

Additionality

The base case indicates that soil carbon will remain low under continued cultivation. There would be no woody biomass carbon under the base case.

The project case indicates that the forest will produce about 73,446 tonnes of carbon in additional wood and 4,568 tonnes of additional soil carbon.

Project Gain = 73,446 + 4,568 = 78,014 tonnes

16

Permanence/Risk

- The Tribe has agreed to provide professional installation, management and protection for the life of the contract.
- The project contract is for 80 years.
- Harvested timber from the project beyond the 80-year term will most likely be used for construction products thereby ensuring long term carbon sequestration.
- The land will remain under Tribal ownership, ensured by the fact that the land is held in trust status by the United States Government.

17

Monitoring/Reporting/Verification

Project area will be monitored yearly for survival, forest health problems, and risk.

Forest carbon will be measured every 5 years with a set of fixed plots, located to provide statistically sound results.

Soil carbon will be measured every 10 years with 30 cm. core samples taken within the fixed forest plots. Soil carbon will be determined by laboratory analysis of samples.

All results will be reported to MCOC within 6 months of monitoring, measurement, or analysis.

18

Monitoring/Reporting/Verification

- An independent, third-party auditor will conduct a verification audit on the project during year 6 and every 5 years thereafter.
- If the Tribe decides to certify its sustainable forest management under a program such as FSC, the certification audit and the carbon audit will be combined.

19

Leakage

- The land was previously forested in the late 1800's and early 1900's. Due to extensive logging and conversion to agriculture in the early 1900's, this land is currently devoid of trees.
- The Nez Perce Tribe manages its entire commercial forest base on a sustainable basis as stipulated in the Forest Management Plan.
- The project will add acreage to the commercial forest base and will not cause any other forested area to be harvested as a result of this project.

20

Additional Benefits

- Reduced soil erosion and siltation of streams and rivers; watershed protection
- Added forest land for Tribal members to gather traditional foods, medicines, and fuels.
- Improved wildlife habitat
- Increased recreational opportunities
- Test market-based conservation approach
- Learn about carbon sequestration projects

21

Marketing Carbon Credits

- The project has been prepared for marketing by the Montana Carbon Offset Coalition. The Coalition is seeking a buyer through its marketing partner, Environmental Financial Products, LLC, who also manage the Chicago Climate Exchange.
- As of September, 2001, the carbon credits in the project had not yet been sold.

22

Credits

- The information for this case study was provided by the Nez Perce Tribal Council and Brian Kummet, Tribal Forester. Carbon calculations were made by Neil Sampson.

23

Further Information

- Birdsey, Richard A. (1996). Carbon Storage in United States Forests, in R. Neil Sampson and Dwight Hair (eds), *Forests and Global Change, Volume II: Opportunities for Improving Forest Management*, Washington, DC: American Forests.

24

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 13: Case Study for Ukraine: Afforestation Project in Kharkiv Region (Ukrlis-Kharkiv)

1. Overview

General Objectives: By the end of the session, participants should have a basic understanding of the following:

- The general approach taken by the sponsors and planners of the project
- The applicability of a similar approach in Ukraine

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 45 minutes

Materials: Set of 20 PowerPoint charts.

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

Case Study for Ukraine: Afforestation Project in Kharkiv Region (Ukrlis-Kharkiv)

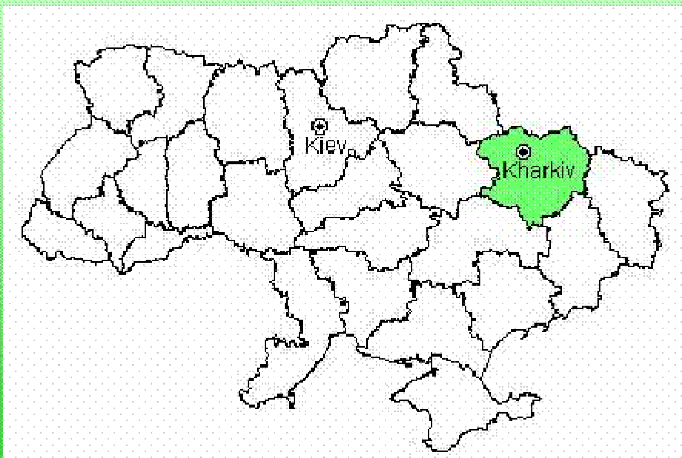
Session 13

Module 9: Carbon Sequestration by Forestry and Agriculture

1

Region of Project Implementation

Afforestation project in Kharkiv region (forest-steppe zone of Ukraine)



2

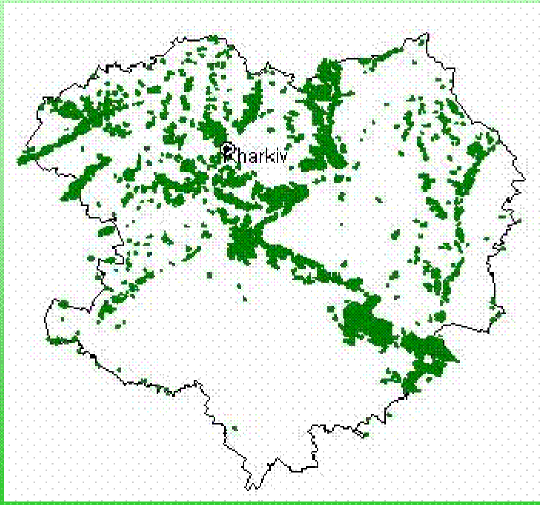
General Description

- The objective of the project is to highlight biological, operational and institutional capabilities of the use of forest plantations in Ukraine as carbon sinks.
- Positive effect in the balance of greenhouse gases is achieved through elimination of carbon emissions (due to prevention of soil erosion and biomass decomposition) and carbon sequestration (due to tree growth and carbon accumulation in soil).
- Length of the project - 60 years.

3

Technical Data – Project Plan

250 hectares (ha) of the former agricultural lands (plots I, II) will be reforested with broad-leaved tree species (mainly, oak, ash, maple and elm), and 250 ha of burnt pine plantations will be reforested on plots III and IV. In these areas near-native forest stands will be created.



4

Project-Based Activity

- establishment of forest cultures;
- additional planting or replanting in case of mortality;
- looking after the trees;
- protection of trees against pests and diseases;
- monitoring, evaluation and verification of carbon sequestration.

5

Possible Losses and Risks

Risks and losses	Losses reduction mechanisms
•forest fires	•spatial distribution of plots
•damage by insects and diseases	•forest protection
•early felling	•protection, conversion of land preservation status, reforestation after felling

6

Post-Project Activity

Felled trees utilisation:

- for house and production buildings where timber will be preserved up to 100 years;
- in mines as pit props which will remain in mines forever after completion of coal mining;
- waste wood can be used as fuel in energy and heating systems.

7

Further Land Utilisation

The forested plots will be used as soil-protection forests of the first group. Therefore, the forest plantations are unlikely to be felled just after expiration of the project lifetime. In future these lands will remain as forest lands.

8

Monitoring and Verification

- annual visits of the territory to evaluate the general progress of the project, condition of plantations and risk assessments;
- measurement of carbon stock in biomass every four years on permanent experimental plots, which represent the whole territory of the project implementation;
- determination of carbon stock in soils every 10 years;
- basic monitoring technology is FHM.

9

Methods to Assess Carbon Deposition in Biomass:

- felling and weighing of small trees on experimental plots in five years;
- measurements on experimental plots in ten years and then under a four-year cycle. Assessment of carbon sequestration is calculated using the coefficients of alometric equations;
- for verification of general conditions and representatives of experimental plots for the first, fifth and then every tenth year air photography will be used.

10

Assessment of Carbon Sequestration by Trees

1. Conversion of timber stock on 1 ha into total biomass of trees (including roots, stumps, and branches):

   200 m^3 x 0.55 = 110 tons of total biomass

2. Conversion of biomass into carbon:

   110 tons x 0.50 (%C) = 55 tons of carbon

3. Total Carbon Sequestration on 500 ha:

   55 tons *ha^{-1} of carbon *500 ha = 27500 tons of carbon

11

Measurement of Carbon Content in Soils

- Assessment of carbon sequestration by soils will be made if project investors wish to receive credit from carbon sequestration by forest soils.
- Monitoring plan includes digging of 20 sections for assessment of soils and random selection of soil samples from different parts of forest plots in the first, tenth and every following ten years.

12

Assessment of Carbon Sequestration by Soils

- obtaining of data on humus horizon (thickness, density and content of organic substance);
- calculation of carbon stock in the upper soil layer (to a depth of 1 m);
- assessment of change in carbon content with preserving lands for agricultural use (comparative scenario);
- assessment of change in carbon content in case of afforestation.

13

Methods of Carbon Emission Calculation for Scenario without Afforestation

Carbon emissions due to erosion on plots I and II:

- annual losses of humus - 0.2 t/ha, annual carbon emissions - 0.2t/ha*0,5 = 0.1 t/ha;
- if the level of carbon losses in soil making 0.1 t/ha per year is maintained during the project lifetime, the total emissions will be (0.10 t/ha per year * 250 ha*60 years) **1500 tons C.**

14

Methods of Carbon Emission Calculation for Scenario without Afforestation (continued)

Carbon emissions due to decomposition of biomass (plots III and IV):

- carbon stock in biomass (71t/ha biomass*0,5*250 ha) = 8875 tons
- total emissions if 90% of biomass will be destroyed during 60 years (8875*0.9) = **7980 tons C**.

Total emissions on 500 ha during 60 years (1500+7980) = 9480 tons C.

15

Volumes of Additional Sequestration and Carbon Emission Reduction under Project:

•Carbon in wood biomass (without the wood carbon removed after thinning) - **27500 tons** C by end of project.

•Decreasing of carbon emission due to stoppage of erosion - **1500 tons C**

•Carbon conservation in wood biomass which is removed from burned area (around 30% from growing stock can be used for building) - **2380 tons C**

Project Gain:27500+1500+2380=31380 tons C

Additional carbon sequestration in soil will be calculated according to monitoring results.

16

Main Items of Expenses on Project

- land allocation and preparation, seedling purchase, seedling planting, looking after cultures and their protection;
- coordination of the project, holding of meetings, adjustment of project-based activity with the state authorities in Kharkiv and Kyiv;
- monitoring, evaluation and verification of carbon sequestration;
- preparation of reports under the project and holding of the partners' meeting in Kharkiv and Kyiv;
- transport costs and compensation for external project verification, and participation in meetings and working sessions.

17

One-Time Expenses on Monitoring

- establishment of the grid of monitoring plots;
- primary survey of soils;
- partial purchase of monitoring equipment;
- development of scientific supporting (e.g. alometric equations) for assessment of carbon sequestration.

18

Current Expenses on Monitoring

- annual visits to forest plantations;
- monitoring to be carried out 6-8 times during the project implementation;
- assessment of carbon sequestration by biomass of trees and roots and survey of soils;
- purchase of airphotos on forested territory or lease of means for the purpose of air survey of forests.

19

For Further Information:

Laboratory of Forest Monitoring and Certification, URIFFM,

86 Pushkin Str.,, Kharkiv 61024,

phone:+80572 431549, fax:+80572 432520,
e-mail: buksha@uriffm.com.ua

20

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 14: Case Study – The RUSAFOR Project

1. Overview

General Objectives: By the end of the session, participants should have a basic understanding of the following:

- The general approach taken by the sponsors and planners of the project
- The applicability of a similar approach in Ukraine

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 30 minutes

Materials: Set of 14 PowerPoint charts.

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
- ***Points***: provide important pieces of information to be shared with participants
- ***Tips***: offer specific guidance to emphasize a point, or otherwise enhance the message

2. Reading and resources

3. http://www.unfccc.int/program/aij/
4. http://www.ji.org/

Case Study – The RUSAFOR Project

Session 14

Module 9: Carbon Sequestration by Forestry and Agriculture

1

The RUSAFOR Project

- Initiated in 1993 as a Russian-American forest carbon offset project.
- Accepted as an AIJ project under USAIJ in 1995 as one of 7 projects in the first round of USIJI.
- Established forest plantations on 4 sites, totaling 900 hectares, in the Saratov Oblast.

2

The RUSAFOR Project

- Partners
  - Oregon State University (OSU)
  - Saratov Forest Management District, Russian Federal Forest Service (SFMD/RFFS)
  - International Forestry Institute, Moscow Branch (IFI/M)
  - International Forestry Institute, Volga Regional Branch (IFI/VRB)
  - U.S. Environmental Protection Agency
  - Sustainable Development Technology Corporation

3

The RUSAFOR Project 4 Sites – 900 ha

Site	Ha	Former Condition	Project Plan
I	210	Marginal agricultural land	Forest plantation (green ash, box elder, elm)
II	240	Marginal agricultural land	Forest plantation (green ash, box elder, elm)
III	50	Burned (1992) forest, soil erosion	Forest plantation (pine)
IV	400	Burned forest (1992), soil erosion	Forest plantation (pine)

4

The RUSAFOR Project
Funding Sources – Project Development

Funding Source	Country	Amount (US$)	(%)
Oregon State University	USA	4,500	41
Russian Federal Forest Service	Russian Federation	4,500	41
International Forestry Institute	Russian Federation	2,000	18
Total		**11,000**	**100**

5

The RUSAFOR Project
Funding Sources – Project Implementation

Funding Source	Country	Amount (US$)	(%)
Oregon State University	USA	50,000	45
Russian Federal Forest Service	Russian Federation	50,000	45
International Forestry Institute	Russian Federation	5,000	5
International Forestry Institute/Volga Branch	Russian Federation	5,000	5
Total		**110,000**	**100**

6

The RUSAFOR Project – Carbon Credits

- The original project planted the first 3 sites – 500 ha. The carbon credits are split 50-50 between OSU and SFMD/RFFS.
- The RFFS planted an additional 400 ha in the vicinity of Site III (Site IV) after the first 3 sites had been planted. The carbon credits on this site belong to RFFS.

7

The RUSAFOR Project – Risk Management

- Identified risks include:
  - Drought, fire
  - Frost
  - Weeds
  - Foraging animals
  - Insects, Disease
- RFFS monitors and will replant in the event of loss or destruction of seedlings.
- Plantations physically separated – one disaster is not likely to affect all of them.

8

The RUSAFOR Project – Indirect or Secondary Impacts

- No indirect or secondary GHG impacts associated with the project have been identified.
- Timber harvest may be done by SFMD at the conclusion of the project. Timber to be used for residential or commercial construction with residual life of 100 years.
- Non commercial timber or slash may be used as biomass fuel in energy or heating systems.

9

The RUSAFOR Project – Carbon benefits projected (3 sites)

- Base case emissions projected – 12,458 tCO_2e cumulative over 60 years.
  - Emissions from continued soil erosion and biomass decomposition from burned-over forest.
- Project Sequestration projected – 113,143 tCO_2e cumulative over 60 years
  - Combined forest and soil increase
- Net GHG Benefits = 125,601 tCO_2e over 60 years.

10

The RUSAFOR Project – Costs for GHG benefits (3 Sites)

- Net GHG benefit = 125,601 tCO_2e
- Costs Incurred
  - Planning 11,000
  - Implementation 110,000
  - Total 121,000
- Cost =~ $US1 per tonne CO_2 equivalent

11

The RUSAFOR Project – Carbon benefits projected (4 sites)

- Base case emissions projected – 59,318 tCO_2e cumulative over 60 years.
  - Emissions from continued soil erosion and biomass decomposition from burned-over forest.
- Project Sequestration projected – 233,410 tCO_2e cumulative over 60 years
  - Combined forest and soil increase
- Net GHG Benefits = 292,727 tCO_2e over 60 years.

12

The RUSAFOR Project – Non-Greenhouse gas benefits

- In addition to sequestering carbon dioxide, the project will:
  - Reduce soil erosion
  - Enhance soil nutrient content
  - Provide habitat for vertebrate and insect species
- Source of pride for surrounding communities
  - Community stewardship enhances monitoring and risk reduction at no cost to sponsors.
- Demonstrated value of partnerships

13

Further Information

- http://www.unfccc.int/program/aij/
- http://www.ji.org/

14

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Session 15: Potential Financial Support for Sequestration Projects

1. Overview

General Objectives: By the end of the session, participants should have a basic understanding of the following:

- The general types of financial support that may be possible forestry and agricultural projects.
- Some policy decisions at national and international levels that might help create financial support.
- The current status of the Joint Implementation opportunity under Article 6.1 of the Kyoto Protocol.
- The current status of private market mechanisms being developed in the United States

Activities: A PowerPoint presentation, followed by a period of questions and answers

Time required: 30 minutes

Materials: Set of 20 PowerPoint charts.

Presenter Guidance: See guidance column below for information on:

- ***Aims***: provide primary or secondary goals of a specific slide that may not be readily apparent from slide text
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2. Reading and Resources

•Material about the Chicago Climate Exchange was furnished by and used with the permission of Environmental Financial Products LLC, Chicago, Illinois, USA. http://www.chicagoclimatex.com
•http://www.me3.org/issues/climate/orgs.html This web site contains web addresses for many organizations involved in tracking emissions trading and market opportunities.
•http://www.thecarbontrader.com Tracks carbon trading activity and news.

Potential Financial Support for Sequestration Projects

Session 15

Module 9: Carbon Sequestration by Forestry and Agriculture

1

Financing Potential

- Remains somewhat uncertain.
- Current financing of projects is largely based on testing of concepts and processes.
- International and/or National policy decisions will be needed.
- Carbon credit values are likely to be only a small portion of total project costs.

2


ІНІЦІАТИВА
CLIMATE
Possible Sources
• AIJ – Activities Implemented Jointly
– Article 6 of the Kyoto Protocol
– Amount of activity likely to be policy driven, largely by actions in Western Europe and U.S.
• Unilateral Government Activity
– European country domestic programs
– U.S. programs
• World Bank Prototype Carbon Fund
• Private Market activity
– Voluntary corporate actions
– Market trading schemes
3


ІНІЦІАТИВА
CLIMATE
Market Drivers Needed
• National regulations constraining carbon emissions
– National policies
• UK, The Netherlands, U.S. proposals
– Sub-national regulations
• U.S. States of Oregon, Massachusetts
• Formal market mechanisms established
• Commitment of private industry
4

Joint Implementation

- Article 6.1, Kyoto Protocol
  - "For the purpose of meeting its commitments under Article 3, any Party included in Annex I may transfer to, or acquire from, any other such Party emission reduction units resulting from projects aimed at reducing anthropogenic emissions by source or enhancing anthropogenic removals by sinks of greenhouse gases in any sector of the economy"

5

Joint Implementation (JI)

- JI pilot program included in FCCC (1992)
  - Project oriented, voluntary
- Expanded in 1995 (to 2000)
  - Activities Implemented Jointly (AIJ)
- After Kyoto, limited to Annex I countries
  - Energy efficiency & renewables
  - Forestry & land use projects

6

Status of AIJ Projects

Type of Project	Number of Projects
Energy Efficiency	62
Renewable Energy	50
Fuel Switching	9
Fugitive Gas Capture	8
Forest Preservation	8
Reforestation	5
Afforestation	4
Agriculture	2

Source: www.unfccc.int

7

JI Concerns

- Transaction costs
- Project baselines
- Monitoring, evaluation, reporting & verification (MERV) requirements
- Meaning of: "a reduction…*additional* to any that would otherwise occur…" (Art. 6.1.a)

8

Future of JI?

- Immediate future (First KP Commitment Period) depends on many other factors and decisions, e.g.:
  - The cap set in Bonn on the amount of credit a country can claim from forest management activities.
  - The ultimate role of the U.S. in the continuing negotiating process.

9

Other Policy Initiatives

- National Action
  - The United Kingdom and The Netherlands are developing regulations to cap carbon emissions.
  - The United States is considering legislation that will cap emissions from energy generation facilities. Whether carbon dioxide will be included is currently being debated.

10

Other Policy Initiatives (Subnational)

- The State of Oregon (United States)
  - CO_2 emissions standard for new energy utilities. Companies can offset emissions with project-based activities.
- The State of Massachusetts (United States)
  - CO_2 emissions cap for energy utilities will take effect in 2005.
- Eastern Canadian premiers and New England governors adopt resolution to reduce GHG emissions in region to 1990 levels within 10 years.

11

Other Policy Initiatives

- World Bank Prototype Carbon Fund
  - Launched in July, 1999
  - Objectives
    - Encourage high quality emission reductions that could meet Kyoto Protocol requirements.
    - Increase the knowledge base in both public and private sectors about climate-friendly actions.
    - Increase public-private cooperation through joint funding and active participation.
  - Limited to US$180 million; will terminate in 2012
  - Currently reviewing $350 million in project proposals

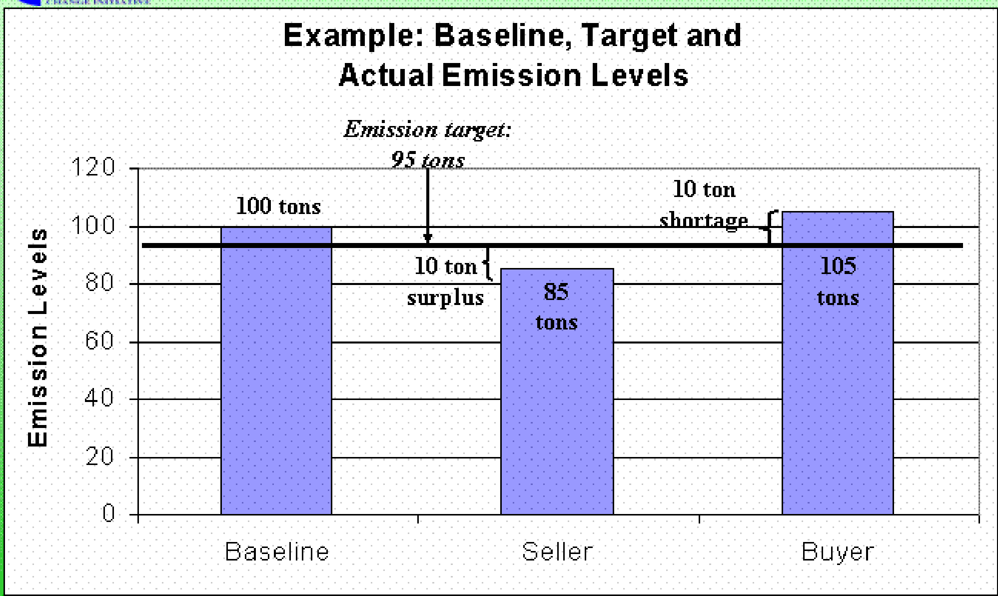
12

Private Market Opportunities

- Currently in testing phase
- Need agreed-upon emissions caps to function.
- Project supply greater than current demand.
- Inadequate activity to establish prices.
- Formal market trading mechanism is being developed in U.S.

13

Emissions Trading: Basics



14

The Chicago Climate Exchange: Creating a Market for GHG Emissions Trading

CCX Overview

The Chicago Climate Exchange is a voluntary pilot greenhouse gas trading program targeting emission sources and offset projects in North America, with limited offset projects in Brazil.

16

Market Implementation

2001	2002	2003	2004
LAUNCH	PHASE 1	PHASE 2	PHASE 3
System launch targeted for the second half of 2001.	Reduction commitments taken by participants in seven-state Midwest region.	Commitments and trading by participants in the entire United States, Canada and Mexico.	Chicago Climate Exchange[SM] expanded to include international participants.

17

Barriers to Trading

- The commodity is not yet well defined.
- Regulations limiting GHGs are not yet in place.
- Lack of uniform standards for monitoring, verification and certification.
- Lack of organized markets.

18

Benefits of Participation

- Gain first-mover advantages; help design protocols
- Build management and trading skills
- Reduce long-term GHG mitigation costs
- Enhance reputation among stockholders
- Reward/encourage environmentally sustainable practices; financial gain to sellers

19

Credits

- Material about the Chicago Climate Exchange was furnished by and used with the permission of Environmental Financial Products LLC, Chicago, Illinois, USA. http://www.chicagoclimatex.com
- http://www.me3.org/issues/climate/orgs.html This web site contains web addresses for many organizations involved in tracking emissions trading and market opportunities.
- http://www.thecarbontrader.com Tracks carbon trading activity and news.

20

MODULE 9: CARBON SEQUESTRATION BY FORESTRY AND AGRICULTURE

Training Module Evaluation Form

Carbon Sequestration by Forestry and Agriculture
Module # 9 **Date**

For each statement below, mark the circle on the scale that corresponds to your opinion.

1 2 3 4 5

1. The presentation Clear O O O O O
Confusing
of this module was

2. The objectives of Relevant O O O O O Not
Relevant
this module were

3. The information Sufficient O O O O O Not
Sufficient
presented in this module was

4. The information Relevant O O O O O Not
Relevant
presented in this module was

5. The information Useful O O O O O Not
Useful
presented in this module was

6. The terminology in Easily O O O O O
Incomprehensible
this module was Comprehensible

7. The module's Clear O O O O O
Confusing
graphical material (e.g.
Transparencies, diagrams, etc.) was

8. The exercises in this module were	Interesting	O O O O O	Not Interesting
9. The exercises in this module were	Useful	O O O O O	Not Useful
10. The knowledge acquired through this module will be	Relevant	O O O O O	Not Relevant
11. The handouts in this module were	Useful	O O O O O	Not Useful
12. Participating in this module enabled you to learn	Many New Things	O O O O O	Nothing New

What did you like most about this module?

What did you like least about this module?

Comments: